MONTHLY WEATHER REVIEW.

Editor: Prof. Cleveland Abbe. Assistant Editor: Herbert C. Hunter.

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FORECAST DIVISION.

Prof. E. B. Garriott, in charge.

RIVERS AND FLOODS.

Two new river forecast districts were created during the year, thereby increasing the total number of districts to 50. On May 1 the district of Phoenix, Ariz., was created, with territory comprising the watershed of the Gila River, formerly a portion of the Denver, Colo., district; and on September 1 the district of Binghamton, N. Y., was created by detaching that portion of the district of Harrisburg, Pa., at and above Binghamton. Several new stations were opened in each of the new districts. A detailed statement of changes during the year follows:

RIVER STATIONS ESTABLISHED.

Station.	District.
Bainbridge, N. Y.	Binghamton, N. Y.
*Boonford, N. C.	Knoxville, Tenn.
*Chillicothe, Ohio	Columbus, Ohio.
*Cortland, N. Y.	Binghamton, N. Y.
*Coshocton, Ohio	Columbus, Ohio.
Elgin, Utah	Denver, Colo.
Ferguson, S. C.	Columbia, S. C.
*Fort Wayne, Ind.	Columbus, Ohio.
Fruita, Colo.	Denver, Colo.
Grand Canyon, Ariz.	Denver, Colo.
*Maricopa, Phoenix, and Salt River Valley railroad bridge over Salt River, Ariz.	Phoenix, Ariz.
†Marble Falls, Tex	Galveston, Tex.
*New Berlin, N. Y.	Binghamton, N. Y.
New Castle, Colo.	Denver, Colo.
*Oneonta, N. Y.	Binghamton, N. Y.
*Rogers, Ind.	Cairo, Ill.
†Running Water, S. Dak.	Sioux City, Iowa.
Sherburne, N. Y.	Binghamton, N. Y.
*Tempe, Ariz.	Phoenix, Ariz.
Thurman, N. Y.	Albany, N. Y.
Topock (P. O. Mellen), Ariz.	Denver, Colo.
Vancouver, Wash	Portland, Oreg.

At the following stations where occasional observations only were taken heretofore, regular daily observations will be taken for at least a portion of each year:

Station.	District.
Harrisburg, Oreg.	Portland, Oreg.
Jefferson, Oreg.	Portland, Oreg.
McMinnville, Oreg.	Portland, Oreg.
Merrill, Iowa	Sioux City, Iowa.
Pasco, Wash. (Columbia River)	Portland, Oreg.
Williamson, W. Va.	Cincinnati, Ohio.

The rainfall station at Pikeville, Ky., Cincinnati, Ohio, district, was discontinued, and a river station established at the same place.

RIVER STATIONS DISCONTINUED.

Station.	District.
Edisto, S. C	Columbia, S. C.
Jackson, Ky	Louisville, Ky.
*Redding, Cal.	Sacramento, Cal.
‡Riparia, Wash	Portland, Oreg.
St. Stephens, S. C.	Columbia, S. C.
Schaghticoke, N. Y.	Albany, N. Y.
*Sherwood, Ohio	Columbus, Ohio.
*Waldo, N. Mex.	Denver, Colo.
Warrensburg, N. Y.	Albany, N. Y.

RAINFALL STATIONS ESTABLISHED.

Station.	District.
*Bangorville, Ohio	Columbus, Ohio.
*Benson, Ariz.	Phoenix, Ariz.
*Cooperstown, N. Y.	Binghamton, N. Y.
*De Ruyter, N. Y.	Binghamton, N. Y.
*Jerome, Ariz.	Phoenix, Ariz.
*Montpelier, Ohio	Columbus, Ohio.
*Newcastle, Va.	Richmond, Va.
*Norwich, N. Y.	Binghamton, N. Y.
*Rockfish, Va.	Richmond, Va.
*San Carlos, Ariz.	Phoenix, Ariz.
*Seligman, Ariz.	Phoenix, Ariz.
Spartanburg, Ariz.	Columbia, S. C.
*Wooster, Ohio	Columbus, Ohio.

RAINFALL STATIONS DISCONTINUED.

Station.	District.
Burkeville, Ala.	Montgomery, Ala.
Enoree, S. C.	Columbia, S. C.
*Mansfield, Ohio	Columbus, Ohio.
*Maxwell City, N. Mex	Denver, Colo.
*Olden, Mo	Little Rock, Ark.

The highest and lowest stages, together with the annual ranges at 201 selected stations, are shown in Table V.—*H. C. Frankenfield, Professor of Meteorology.*

* Occasional reports only. † Beginning January 1, 1908. ‡ To be reopened February 1, 1908.

GENERAL CLIMATIC CONDITIONS.

By Mr. P. C. Day, Assistant Chief, Division of Meteorological Records.

PRESSURE.

The distribution of the mean sea-level pressure during 1907 over the United States and Canada is graphically shown on Chart VI, and the average values and departures from the normal are shown for each station in Tables I and IV.

The variations from the normal pressure distribution during the several months of the year were not sufficient to produce any marked departure from the normal annual distribution, and variations from the latter were not pronounced in any district.

The annual average pressure was slightly below normal over the eastern districts of Canada, New England, the lower Lake region, and Middle Atlantic States, and also over the Pacific coast districts from central California northward. Over the remaining districts of the United States and Canada pressure averaged slightly higher than usual. The maximum departure, +.05 to +.07 inch, occurred over eastern Montana and the western portions of North Dakota and South Dakota.

Average pressure of 30.05 inches, or slightly higher, was maintained over the Ohio Valley, south Atlantic and east Gulf districts, and locally in the upper Missouri Valley and along the coast of northern California.

Over portions of New Mexico, Arizona, and southeastern California the annual pressure averaged about 29.90 inches.

TEMPERATURE.

The mean annual temperature over the various portions of the United States did not differ widely from the normal distribution, but an analysis of the various seasons making up the yearly record shows many abnormal features.

The most notable of the wide fluctuations in the seasonal temperature were the extreme warmth of the latter part of March over the districts east of the Rocky Mountains, and the continued cold attending the progress of the later spring and early summer months over the greater part of the same districts.

Details of the above, with other important temperature variations, appear in the summary of the weather during the respective months.

Temperature was below the normal during the greater part of the year over all northern districts of the United States and also over the whole of Canada, except portions of British Columbia. The total deficiency, however, was generally less than 2°. Over the southern portions of the United States there was a corresponding excess, which prevailed by small amounts during most of the months of the year.

Within the United States proper the extremes of temperature were not beyond the limits of former years. Maximum temperatures from 120° to 124° occurred in portions of southern Arizona and southeastern California, and minimum temperatures from 50° to 52° below zero were reported from the northern portions of Minnesota and Wisconsin.

A minimum temperature of 58° below zero was recorded at White River, Ontario, Canada, and the same temperature was reported from Dawson, in the Yukon district, while in the interior of Alaska temperatures as low as −66° were recorded.

The annual range of temperature varied from 35° at Key West, in southern Florida, to 147° at Williston, in the northern portion of North Dakota.

PRECIPITATION.

The distribution of precipitation during the year is graphically shown on Chart IV, and the variations from the average are shown on Chart XI.

In general the precipitation for the year was above the normal in the central portions of the Middle Atlantic States, portions of the Lake region, the Ohio and middle Mississippi valleys, the central Gulf States, and in the Rocky Mountain and Plateau districts, and portions of western Oregon and northern California.

Over the south Atlantic coast, the southern Appalachian region, Florida Peninsula, the west Gulf States, the Great Plains from Texas to the northern boundary, portions of the Lake region, and along the north Pacific coast there was a general and well-marked deficiency in the annual precipitation.

Along the immediate Atlantic coast from Chesapeake Bay to Florida, and over eastern Texas and the western portions of Louisiana and Arkansas, the deficiency ranged from about 5 to more than 20 inches.

The general distribution of precipitation during the various seasons of the year was such that except over small areas there was no important interest that suffered materially from either excess or deficiency of moisture.

The distribution of thunderstorms over the United States and Canada is graphically presented on Chart X, the marked feature of which is the uniform rate in which the number of thunderstorm days decreased from south to north over the Atlantic coast and interior valley districts and their infrequent occurrence along the Pacific coast.

RELATIVE HUMIDITY.

Over the Atlantic coast and Gulf districts the relative humidity averaged somewhat less than the normal for the year, while over the remaining districts it was generally in excess of the normal.

Over the Rocky Mountains and Plateau districts the excess ranged from 5 to 15 per cent, a condition which prevailed over portions of the districts during each month of the year.

TABLE I.—*Annual climatological summary, Weather Bureau stations, 1907.*

Districts and stations.	Elevation of barometer above sea level.	Pressure in inches.*: Actual, reduced to mean of 24 hours.	Pressure: Sea level, reduced to mean of 24 hours.	Pressure: Departure from normal.	Temperature of the air, in degrees Fahrenheit: Mean max.+mean min.÷2.	Temperature: Departure from normal.	Temperature: Maximum.	Temperature: Mean maximum.	Temperature: Minimum.	Temperature: Mean minimum.	Temperature: Annual range.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation: Total, in inches.	Precipitation: Departure from normal.	Precipitation: Days with .01, or more.	Winds: Total movement, miles.	Winds: Prevailing direction.	Winds: Max. velocity: Miles, per hour.	Winds: Max. velocity: Direction.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall, inches.†
New England.					45.8	−1.5							75	40.97	− 0.85									5.7	
Eastport	76	29.87	29.96	−.01	40.1	−1.0	88	47	−20	33	108	34	79	44.42	+ 1.15	143	100,366	sw.	60	e.	59	134	172	6.9	167.6
Portland, Me	103	29.87	29.99	−.01	43.3	−2.1	95	50	−16	36	111	34	72	40.84	− 1.67	127	79,234	nw.	54	nw.	118	105	142	5.6	119.5
Concord	288	29.67	29.99	−.03	43.8	−1.8	94	54	−12	34	106	.....	.....	39.36	− 0.85	115	47,600	nw.	50	ne.	195	80	90	4.1	84.6
Burlington	404	29.55	30.00	−.01	41.9	−3.9	92	50	−17	33	109	.....	.....	29.67	− 1.86	150	98,276	s.	60	se.	75	117	173	6.6	71.6
Boston	125	29.86	30.00	−.01	48.7	−0.1	94	56	− 7	41	101	39	71	37.56	− 5.82	130	93,073	w.	52	nw.	97	117	151	6.0	67.9
Nantucket	12	29.98	29.99	−.03	47.9	−1.7	84	54	2	42	82	41	81	45.97	+ 8.97	143	141,230	sw.	70	ne.	113	114	138	6.0	49.2
Block Island	26	29.98	30.01	−.01	47.9	−1.7	85	54	− 1	42	86	41	80	39.90	− 4.46	131	150,161	sw.	70	ne.	119	136	110	5.3	24.6
Providence	160	29.84	30.01	−.01	48.0	−1.8	92	57	− 9	39	101	38	72	40.55	− 2.83	139	61,356	w.	37	w.	125	126	114	5.4	71.4
Hartford	159	29.84	30.02	.00	48.0	−0.5	94	57	− 9	39	103	38	72	45.20	− 0.11	125	60,804	nw.	44	nw.	73	136	156	6.3	74.7
New Haven	106	29.90	30.02	−.01	48.7	−0.8	90	57	− 7	40	97	39	72	46.19	− 1.00	127	79,627	nw.	48	s.	140	117	108	5.1	64.3
Middle Atlantic States.					52.0	−1.0							74	41.60	+ 1.93									5.6	
Albany	97	29.92	30.02	−.01	46.9	−0.7	95	56	−11	38	166	38	75	33.63	− 2.75	126	67,325	s.	37	nw.	77	150	138	6.1	46.8
Binghamton	871	29.08	30.02	−.02	45.0	−1.6	93	54	−15	36	108	.....	.....	29.79	− 3.15	143	54,247	w.	44	w.	68	91	206	7.0	60.9
New York	314	29.68	30.02	−.02	51.2	−0.5	91	58	0	44	91	41	71	45.28	+ 0.65	140	102,349	nw.	59	w.	111	130	124	5.5	52.4
Harrisburg	374	29.65	30.05	.00	50.4	−1.2	90	58	3	42	87	40	71	36.25	− 1.02	140	62,478	nw.	40	w.	111	123	131	5.6	42.1
Philadelphia	117	29.92	30.04	−.01	53.1	−0.5	93	61	6	46	87	43	72	48.74	+ 7.57	147	88,916	nw.	40	n.	101	109	155	5.9	38.6
Scranton	805	29.15	30.03	−.01	47.7	−1.0	92	56	− 6	39	98	37	71	34.53	− 2.52	153	62,926	sw.	42	w.	74	132	159	6.4	64.8
Atlantic City	52	29.99	30.04	.00	51.0	−1.4	91	58	4	44	87	43	77	48.54	+ 7.72	137	74,059	sw.	41	ne.	102	110	153	5.9	26.0
Baltimore	123	29.91	30.04	−.01	53.6	−1.5	93	62	9	46	84	42	69	49.09	+ 5.91	141	63,024	nw.	46	nw.	111	104	150	5.7	31.1
Washington	112	29.93	30.05	−.01	53.5	−1.2	93	63	3	44	90	44	76	44.66	+ 1.16	130	53,658	nw.	38	w.	142	109	114	5.2	28.3
Cape Henry	18	30.03	30.05	......	57.6	......	97	65	19	50	78	.....	.....	28.44	....	121	120,535	s.	59	nw.	166	112	87	4.5	7.3
Lynchburg	681	29.32	30.06	−.01	56.0	−0.4	95	66	6	46	89	46	76	43.88	+ 0.46	126	34,537	nw	36	nw.	132	141	92	5.2	13.1
Norfolk	91	29.96	30.06	+.01	58.6	−0.5	95	67	19	51	76	48	75	38.72	−10.82	130	80,835	s.	52	sw.	139	112	114	5.1	5.0
Richmond	144	29.91	30.06	.00	57.0	−1.5	96	67	12	47	84	.....	.....	48.48	+ 6.85	131	71,978	s.	53	s.	151	114	100	4.7	21.2
Wytheville	2,293	27.68	30.06	−.01	52.2	−0.4	89	62	5	42	84	44	82	39.16	− 7.55	158	48,578	w.	38	w.	145	113	107	4.9	15.9
South Atlantic States.					63.0	+0.8							78	41.32	− 9.58									4.8	
Asheville	2,255	27.72	30.08	+.01	55.1	+1.0	91	66	16	45	75	47	81	31.53	−18.03	134	65,151	nw.	40	se.	108	143	114	5.4	5.0
Charlotte	773	29.24	30.07	.00	60.0	+0.1	97	69	18	51	79	48	71	39.98	− 9.22	121	59,367	sw.	42	sw.	123	117	125	5.4	4.3
Hatteras	11	30.04	30.05	−.01	61.3	+0.9	93	67	27	55	66	56	86	44.56	−15.29	108	129,959	sw.	58	w.	208	92	65	3.9	0.3
Raleigh	376	29.66	30.06	.00	59.7	+0.1	98	70	15	50	83	48	72	47.78	− 1.92	115	54,647	sw.	34	nw.	149	117	99	4.8	6.3
Wilmington	78	29.99	30.07	+.01	62.8	+0.6	100	72	21	54	79	53	78	52.25	+ 1.20	125	69,092	sw.	50	nw.	134	167	64	4.6	
Charleston	48	30.02	30.07	.00	66.3	+0.7	100	73	27	59	73	57	80	31.71	−20.36	123	91,914	sw.	50	n.	137	146	82	4.7	
Columbia, S.C.	351	29.68	30.07	.00	63.6	+0.4	101	74	22	54	79	51	72	38.98	− 7.10	121	59,216	sw.	48	sw.	104	150	111	5.5	0.6
Augusta	180	29.87	30.06	−.01	64.6	+1.0	102	75	24	55	78	53	75	38.93	− 8.96	122	51,573	nw.	50	w.	156	136	73	4.3	T.
Savannah	65	30.00	30.07	+.01	67.3	+1.8	100	76	29	59	71	57	78	42.45	− 7.89	114	65,645	sw.	37	s.	134	129	102	5.0	
Jacksonville	43	30.02	30.08	+.02	69.6	+1.4	97	78	31	61	66	61	83	45.07	− 8.18	114	79,218	sw.	62	sw.	152	139	74	4.6	
Florida Peninsula.					74.9	+1.2							78	31.44	−16.40									3.7	
Jupiter	28	30.03	30.06	+.03	74.7	+0.9	96	82	43	68	53	67	80	39.83	−20.42	118	91,997	se.	40	nw.	101	234	30	4.8	
Key West	22	30.02	30.03	+.01	77.4	+0.6	92	82	57	72	35	68	75	26.65	−12.01	94	78,339	ne.	50	w.	199	130	36	3.6	
Tampa	35	30.04	30.07	+.03	72.5	+2.1	93	81	36	64	57	62	78	43.45	−10.32	98	67,337	ne.	44	sw.	243	93	26	2.8	T.
East Gulf States.					65.9	+1.5							76	54.71	+ 2.03									5.3	
Atlanta	1,174	29.84	30.07	.00	61.7	+0.8	98	70	22	53	76	49	70	39.43	− 9.93	120	92,111	nw.	60	nw.	155	82	128	5.0	T.
Macon	370	29.68	30.07	+.01	65.3	+2.4	102	76	25	55	77	.....	.....	40.88	− 6.12	102	39,459	nw.	36	w.	154	105	106	4.7	
Thomasville	273	29.78	30.07	+.01	67.8	+0.7	99	79	27	57	72	58	81	56.02	+ 5.55	126	45,488	s.	41	sw.	146	123	96	4.6	
Pensacola	56	30.01	30.07	+.02	68.6	+0.7	98	75	32	62	66	.....	.....	67.08	+10.83	109	85,530	ne.	50	s.	123	111	131	5.4	
Anniston	741	29.30	30.09	+.03	62.1	+1.4	99	73	20	51	79	.....	.....	51.28	+ 1.92	119	46,675	se.	39	se.	111	106	148	5.8	0.3
Birmingham	700	29.31	30.08	+.02	63.6	0.0	98	72	19	55	79	52	73	54.59	+ 5.11	117	65,162	n.	58	ne.	85	156	124	5.9	T.
Mobile	57	30.00	30.06	+.01	68.5	+2.4	98	76	32	61	66	59	79	70.53	+ 8.49	123	65,693	n.	43	nw.	102	151	112	5.5	
Montgomery	223	29.83	30.08	+.02	65.9	+0.8	98	75	25	56	73	54	74	49.83	− 1.33	102	55,511	sw.	43	sw.	111	145	109	5.3	
Meridian	375	29.67	30.06	.00	64.6	+1.5	98	75	23	54	75	55	77	54.21	+ 1.01	113	45,668	sw.	32	nw.	150	99	116	4.9	T.
Vicksburg	247	29.78	30.06	.00	66.4	+1.6	96	75	26	58	70	55	78	51.60	− 2.14	96	56,592	se.	48	nw.	114	145	106	5.2	0.2
New Orleans	51	30.00	30.05	+.01	70.4	+2.2	97	78	34	63	63	61	78	66.32	+ 8.90	116	74,626	s.	48	se.	104	126	135	5.6	
West Gulf States.					66.5	+1.7							74	35.15	− 5.49									4.8	
Shreveport	249	29.78	30.05	+.02	66.8	+1.6	102	76	24	57	78	54	71	39.05	− 6.63	92	59,088	se.	46	n.	183	98	84	4.2	
Fort Smith	457	29.54	30.02	−.01	62.1	+1.6	103	72	16	52	87	50	71	35.58	− 5.76	86	70,638	e.	66	w.	164	111	90	4.8	0.7
Little Rock	357	29.67	30.05	+.01	63.0	+1.5	103	72	18	54	85	51	70	50.56	+ 0.67	93	67,335	s.	48	nw.	108	125	132	5.5	1.0
Corpus Christi	20	29.99	30.01	+.02	71.9	+1.9	92	78	36	66	56	64	82	16.21	−10.97	70	99,815	se.	38	se.	139	143	83	4.6	
Fort Worth	670	29.31	30.02	+.01	66.3	+1.3	102	77	20	56	82	.....	.....	30.53	+ 3.64	73	91,127	s.	45	nw.	163	160	42	4.1	1.0
Galveston	54	29.99	30.05	+.02	71.0	+1.6	93	76	36	67	57	64	82	43.93	− 3.13	99	101,951	se.	62	nw.	125	155	85	5.0	
Palestine	510	29.48	30.02	.00	67.0	+1.8	99	76	24	58	75	55	74	38.01	− 5.01	91	67,968	s.	36	n.	98	118	149	5.9	1.4
San Antonio	701	29.27	29.99	.00	70.4	+2.5	105	81	28	60	77	56	70	27.77	+ 0.94	83	63,316	se.	60	nw.	148	133	84	4.7	T.
Taylor	583	29.40	30.02	+.02	68.4	+1.9	102	79	25	58	77	.....	.....	32.23	− 2.24	85	80,842	s.	44	n.	161	101	103	4.6	T.
Ohio Valley and Tenn.					55.3	−0.3							73	43.82	+ 0.48									5.8	
Chattanooga	762	29.28	30.09	+.02	60.8	+0.9	96	70	19	51	77	49	71	42.37	− 8.31	132	57,010	sw.	48	w.	127	118	120	5.3	6.9
Knoxville	1,004	29.01	30.07	.00	58.4	+1.0	96	68	15	49	81	47	72	43.80	− 5.55	136	54,818	sw.	58	sw.	85	117	163	6.2	5.8
Memphis	399	29.65	30.08	+.03	62.4	+1.1	98	70	17	54	81	52	73	41.55	− 8.79	108	76,565	sw.	60	w.	158	87	120	4.9	0.7
Nashville	546	29.50	30.08	+.02	59.9	+0.6	100	70	12	50	88	48	71	37.42	−11.07	130	52,161	sw.	36	w.	120	87	158	5.8	7.0
Lexington	989	29.00	30.08	+.02	53.8	−1.2	92	63	1	45	91	.....	.....	41.37	− 0.71	141	89,079	s.	52	nw.	154	80	131	5.2	28.0
Louisville	525	29.49	30.07	+.01	56.5	−0.3	98	66	4	47	94	45	70	47.48	+ 3.15	132	69,510	sw.	60	w.	106	117	142	5.8	17.7
Evansville	431	29.57	30.04	−.01	56.3	−0.1	98	65	5	48	93	.....	.....	46.67	+ 3.51	120	61,526	s.	52	sw.	111	165	89	5.3	15.5
Indianapolis	822	29.16	30.05	+.01	51.7	−1.0	93	60	2	43	91	42	73	38.56	− 2.92	127	83,158	s.	52	sw.	90	115	160	6.2	10.4
Cincinnati	628	29.38	30.07	+.01	54.2	−1.0	95	63	4	46	91	43	69	44.56	+ 7.23	142	59,758	se.	42	sw.	103	113	149	6.0	15.8
Columbus	824	29.17	30.05	.00	50.8	−1.3	92	60	− 1	42	93	41	74	37.58	+ 0.66	147	101,704	nw.	66	nw.	94	118	153	6.0	19.7
Pittsburg	842	29.13	30.04	−.01	50.7	−2.0	89	59	0	42	89	41	72	34.86	− 1.49	153	86,758	nw.	62	w.	85	123	157	6.3	36.5
Parkersburg	638	29.40	30.06	.00	53.1	−0.5	92	62	− 6	44	98	44	77	48.07	+ 7.85	162	51,583	s.	43	nw.	119	106	140	5.8	19.8
Elkins	1,940	28.00	30.08	+.02	49.7	−0.2	87	60	−14	39	101	41	81	65.37	+22.62	214	35,076	w.	31	w.	81	131	153	6.4	47.1
Lower Lake Region.					46.1	−1.7							76	34.37	− 0.59									6.3	
Buffalo	767	29.17	30.01	−.01	45.4	−1.6	87	52	− 4	39	91	38	77	34.97	− 2.31	176	129,577	sw.	84	sw.	56	163	146	6.5	53.5
Oswego	335	29.63	30.00	−.02	44.6	−2.2	90	52	−10	38	100	37	78	38.36	+ 1.18	169	94,486	s.	52	w	73	95	197	6.6	61.3
Rochester	523	29.44	30.02	.00	46.3	−0.7	92	54	− 6	38	98	37	73	27.60	− 6.67	157	77,920	sw.	54	w.	72	118	180	6.7	63.7
Syracuse	597	29.36	30.01	−.02	45.2	−2.0	90	53	−14	38	104	.....	.....	32.30	− 2.00	175	102,917	s.	66	s.	67	127	171	6.6	91.6
Erie	713	29.24	30.02	−.01	47.1	−1.7	87	54	− 3	40	90	38	74	37.95	− 0.60	164	96,955	w.	55	se.	87	109	169	6.4	35.2
Cleveland	762	29.20	30.03	−.01	47.6	−1.7	88	55	− 2	40	90	38	73	34.76	− 0.28	163	130,545	se.	68	w.	81	144	140	6.2	55.4
Sandusky	629	29.34	30.03	−.01	48.6	−1.4	90	56	0	41	90	.....	.....	38.44	+ 4.42	141	73,709	sw.	48	nw.	112	103	150	5.7	15.0
Toledo	628	29.35	30.04	+.01	48.3	−1.3	89	56	− 2	40	91	40	76	35.03	+ 4.41	143	121,061	sw.	70	sw.	127	112	126	5.4	23.5
Detroit	730	29.23	30.03	.00	46.6	−1.6	87	54	− 5	39	92	39	78	30.62	− 1.54	139	107,217	w.	54	sw.	91	113	161	6.2	31.6
Upper Lake Region.					42.0	−1.1							77	29.28	− 2.42									6.1	
Alpena	609	29.33	30.01	.00	41.2	−0.5	98	50	−11	33	109	34	79	22.68	−10.52	155	94,381	nw.	50	nw.	79	132	164	6.3	50.5
Escanaba	612	29.34	30.02	+.01	39.7	−0.9	90	48	−17	32	107	32	75	24.30	− 7.21	132	87,850	s.	55	nw.	180	124	111	5.2	71.9
Grand Haven	632	29.32	30.02	.00	44.8	−1.9	86	52	0	38	86	38	78	36.04	+ 4.67	145	103,164	nw.	50	w.	73	133	159	6.6	44.7
Grand Rapids	707	29.25	30.03	+.01	46.0	−2.1	91	54	− 3	38	94	38	77	33.39	+ 1.92	143	90,649	nw.	50	w.	76	97	192	6.8	30.1
Houghton	668	29.26	30.00	.00	38.4	−1.8	96	47	−24	30	119	.....	.....	30.35	− 2.27	156	63,802	e.	38	n.	81	148	136	6.0	153.8
Marquette	734	29.20	30.02	+.02	39.2	−1.3	91	46	−13	32	104	30	74	31.62	− 1.01	161	92,462	nw.	58	sw.	63	139	157	6.4	132.6
Port Huron	638	29.32	30.02	.00	44.4	−0.9	90	53	− 5	36	95	37	78	27.42	− 3.23	134	99,809	sw.	58	w.	98	112	155	6.1	50.9
Sault Sainte Marie	614	29.31	30.02	+.02	36.9	−1.5	86	45	−23	29	109	31	80	24.42	− 6.96	154	80,697	nw.	61	nw.	72	91	202	7.0	67.4
Chicago	823	29.14	30.04	−.01	49.2	+0.7	92	56	− 3	42	95	41	76	35.10	+ 1.98	127	126,071	sw.	60	w.	93	130	142	5.9	29.8
Milwaukee	681	29.30	30.05	+.03	45.5	+0.2	92	53	− 9	38	101	37	74	34.90	+ 3.50	124	91,961	w.	42	e.	126	114	125	5.4	28.1

TABLE I.—*Annual climatological summary, Weather Bureau stations, 1907*—Continued.

Districts and stations.	Elevation of barometer above sea level.	Pressure in inches.* Actual, reduced to mean of 24 hours.	Pressure: Sea level, reduced to mean of 24 hours.	Pressure: Departure from normal.	Temperature of the air, in degrees Fahrenheit. Mean max. + mean min. ÷ 2.	Temp.: Departure from normal.	Temp.: Maximum.	Temp.: Mean maximum.	Temp.: Minimum.	Temp.: Mean minimum.	Temp.: Annual range.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation. Total, in inches.	Precip.: Departure from normal.	Precip.: Days with .01, or more.	Winds. Total movement, miles.	Winds: Prevailing direction.	Winds: Max. velocity. Miles, per hour.	Winds: Max. velocity. Direction.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall, inches.†
Upper Lake Region—Con.																									
Green Bay	617	29.33	30.00	−.01	42.9	+0.1	92	51	−16	35	108	34	74	27.32	−3.80	118	90,310	sw.	48	nw.	74	117	174	6.7	40.1
Duluth	1,133	28.76	30.01	.00	36.4	−3.0	88	45	−28	28	116	28	77	23.87	−6.06	117	118,587	ne.	60	nw.	119	116	130	5.3	62.4
North Dakota.					**36.8**	**−1.7**							**74**	**16.18**	**−4.41**									**5.2**	
Moorhead	940	29.00	30.04	+.03	37.8	−0.6	94	48	−34	27	128	32	83	23.02	−1.90	94	77,042	nw.	39	e.	97	137	131	5.5	67.4
Bismarck	1,674	28.24	30.06	+.06	39.0	−1.0	98	51	−39	27	137	27	69	16.55	−1.09	86	90,542	nw.	70	w.	173	110	82	4.5	48.7
Devils Lake	1,482	28.40	30.01	+.01	34.4	−2.0	90	46	−40	23	130	26	75	14.97	−9.84	96	105,343	w.	52	w.	149	102	114	4.9	70.8
Williston	1,875	27.99	30.02	+.03	36.2	−3.2	98	49	−49	24	147	25	71	10.18	−4.81	73	78,428	nw.	55	nw.	96	145	124	5.8	33.2
Upper Miss. Valley.					**49.4**	**−0.2**							**75**	**34.16**	**+0.30**									**5.4**	
St. Paul	837	29.10	30.02	+.01	42.5	−1.4	92	51	−22	34	114	32	70	23.07	−5.61	93	91,121	nw.	47	nw.	96	153	116	6.0	38.6
La Crosse	714	29.24	30.02	.00	45.0	−0.9	92	54	−20	36	112	.....	.....	28.41	−2.76	104	63,671	s.	50	nw.	80	120	165	6.3	30.4
Madison	974	28.96	30.02	.00	44.6	−0.8	89	53	−13	37	102	37	78	30.29	−1.42	119	86,762	nw.	44	n.	121	108	136	5.6	22.3
Charles City	1,015	28.94	30.04	+.02	43.9	−0.7	91	54	−24	34	115	37	82	32.67	+1.44	102	68,128	nw.	36	nw.	86	135	144	6.1	30.5
Davenport	606	29.37	30.04	+.01	49.6	+0.2	95	58	−6	41	101	41	75	33.29	+0.60	103	65,545	nw.	38	nw.	145	94	126	5.1	21.1
Des Moines	861	29.12	30.04	+.02	48.9	−0.4	94	58	−12	40	106	39	72	34.02	+1.57	107	71,998	sw.	47	sw.	80	171	114	5.9	30.7
Dubuque	698	29.29	30.05	+.03	47.2	−0.5	93	56	−14	38	107	38	75	32.19	−1.82	118	59,522	nw.	42	n.	128	107	130	5.3	19.7
Keokuk	614	29.37	30.05	+.02	52.2	+0.8	95	61	−6	43	101	42	75	38.80	+3.73	105	60,009	nw.	36	nw.	187	104	74	4.1	15.8
Cairo	356	29.68	30.06	+.01	58.4	+0.8	97	67	10	50	87	49	75	45.58	+3.87	116	75,346	s.	54	nw.	127	101	137	5.4	14.0
Peoria	609	29.38	30.05	+.02	50.0	+0.1	94	60	−9	40	103	41	76	34.88	−1.41	129	71,879	s.	58	n.	144	109	109	4.7	19.4
Springfield, Ill.	644	29.35	30.04	.00	52.9	+0.5	97	62	0	44	97	43	74	41.08	+4.12	126	76,989	s.	36	sw.	136	96	133	5.2	11.2
Hannibal	534	29.46	30.04	+.01	52.7	−0.4	95	62	−6	44	101	.....	.....	35.52	+1.26	115	78,787	sw.	56	ne.	128	111	126	5.4	20.4
St. Louis	567	29.43	30.04	.00	55.3	−0.5	98	63	3	47	95	45	72	41.39	+4.19	122	92,393	s.	52	w.	136	104	125	5.2	13.7
Missouri Valley.					**50.3**	**+0.6**							**68**	**26.82**	**−2.70**									**5.0**	
Columbia, Mo.	784	29.19	30.03	.00	53.8	+0.3	96	64	−6	44	102	.....	.....	36.74	+0.13	120	69,472	s.	44	w.	168	76	121	4.6	17.4
Kansas City	963	29.00	30.04	.00	54.7	+1.5	98	64	−5	46	103	43	70	37.59	+0.31	109	84,185	s.	48	nw.	146	124	95	4.7	18.0
Springfield, Mo.	1,324	28.63	30.03	.00	56.4	+1.6	100	66	4	47	96	45	72	40.50	−4.07	130	87,450	se.	53	sw.	183	77	105	4.3	11.0
Topeka	.....	.....	.....	.....	54.3	+1.0	100	65	−4	44	104	.....	.....	27.49	−6.27	106	77,119	s.	45	s.	150	106	100	4.6	17.0
Lincoln	1,189	28.74	30.02	+.01	50.7	+0.6	100	61	−12	40	112	38	67	27.30	−0.21	87	91,297	s.	52	n.	152	120	93	4.8	24.2
Omaha	1,105	28.84	30.03	+.01	50.3	+0.3	97	59	−12	41	109	38	68	24.60	−6.06	95	78,170	nw.	48	n.	110	112	143	3.8	25.2
Valentine	2,598	27.28	30.03	+.03	45.9	−0.4	102	59	−14	33	116	32	67	16.21	−6.25	87	92,045	nw.	60	nw.	139	172	54	4.5	42.9
Sioux City	1,135	28.80	30.04	+.02	46.8	−0.8	98	57	−22	37	120	.....	.....	19.93	−6.03	89	112,873	nw.	66	nw.	117	113	135	5.5	24.9
Pierre	1,572	28.35	30.04	+.04	45.6	0.0	107	57	−16	34	123	31	63	14.02	−2.61	95	84,610	se.	62	sw.	135	128	102	4.9	34.8
Huron	1,306	28.63	30.05	+.04	42.4	+0.3	96	54	−22	30	118	32	72	15.05	−6.05	95	97,587	se.	51	nw.	135	123	107	5.0	30.9
Yankton	1,233	28.69	30.03	+.02	46.4	−0.2	98	57	−24	36	122	.....	.....	25.71	+0.28	88	71,645	nw.	44	nw.	89	97	179	6.3	29.9
Northern Slope.					**45.0**	**−0.3**							**68**	**15.06**	**−0.15**									**4.8**	
Havre	2,505	27.33	30.01	+.04	39.3	−2.6	92	52	−45	27	137	30	74	13.28	−0.39	91	72,534	nw.	49	w.	170	136	59	4.4	58.1
Miles City	2,371	27.47	30.06	+.07	44.6	+0.3	104	57	−33	32	137	32	69	14.75	+1.58	96	49,968	ne.	44	w.	166	132	67	4.1	35.8
Helena	4,110	25.80	30.04	+.03	42.6	−0.6	87	53	−21	32	108	28	63	12.74	−0.03	100	55,603	sw.	48	w.	117	115	133	5.6	62.0
Kalispell	2,962	26.92	30.01	+.02	42.1	−0.3	90	53	−19	32	109	32	74	16.94	0.00	131	41,302	w.	32	w.	94	147	124	5.7	58.1
Cheyenne	6,088	24.00	29.99	+.02	45.5	+0.6	91	58	−9	33	100	29	61	12.34	−1.26	91	88,912	nw.	56	w.	123	147	93	4.9	67.9
Lander	5,372	24.63	30.02	+.02	43.1	+1.0	91	58	−27	28	118	28	63	10.50	−3.42	72	34,123	sw.	46	sw.	121	183	61	4.7	72.0
Yellowstone Park	6,200	23.86	30.03	+.02	38.2	−1.2	80	49	−19	27	99	26	66	20.35	+1.55	154	66,729	sw.	42	sw.	87	197	81	5.2	117.5
North Platte	2,821	27.09	30.04	+.05	48.7	+0.5	100	62	−8	35	108	36	72	19.61	+0.75	95	65,860	se.	69	sw.	186	85	94	4.0	30.6
Middle Slope.					**54.7**	**+1.2**							**64**	**20.50**	**−2.10**									**4.7**	
Denver	5,291	24.72	29.98	+.02	50.9	+1.1	94	64	−2	38	96	31	54	11.83	−2.19	83	64,953	s.	43	w.	144	157	64	4.5	85.6
Pueblo	4,685	25.28	29.98	+.08	52.9	+1.9	96	67	1	39	95	30	51	9.56	−2.39	64	61,875	nw.	61	w.	185	135	45	3.7	24.9
Concordia	1,398	28.54	30.03	+.02	53.4	+0.8	102	64	−3	42	105	41	70	24.05	−3.42	70	64,053	s.	36	s.	112	170	83	4.9	21.0
Dodge	2,509	27.40	30.01	+.03	54.6	+1.2	100	67	−2	42	102	39	65	18.26	−2.58	78	81,027	se.	41	w.	133	157	75	4.9	12.3
Wichita	1,358	28.60	30.04	+.03	56.6	+1.0	102	67	0	46	102	44	68	31.51	+0.90	95	75,919	s.	39	nw.	128	142	95	5.1	13.9
Oklahoma	1,214	28.72	30.00	.00	60.0	+1.3	102	71	9	49	93	48	73	28.79	−2.90	76	136,102	s.	58	s.	134	123	108	5.1	4.5
Southern Slope.					**63.6**	**+2.0**							**63**	**16.95**	**−5.52**									**4.4**	
Abilene	1,738	28.20	29.99	+.01	65.7	+2.7	110	77	16	54	94	48	62	18.33	−6.41	59	75,015	s.	40	nw.	120	165	80	4.9	2.9
Amarillo	3,676	26.25	29.97	+.01	57.4	+2.3	104	71	7	44	97	42	67	18.09	−4.46	69	109,275	s.	56	w.	213	108	44	4.0	33.6
Del Rio	944	28.99	29.97	+.01	71.0	+2.4	106	83	28	50	78	.....	.....	17.95	−8.88	64	74,295	e.	66	ne.	168	128	69	4.3	T.
Roswell	3,578	26.32	29.93	.00	60.1	+0.6	104	75	17	45	87	41	60	13.43	−2.33	56	52,664	s.	46	n.	152	149	64	4.4	23.1
Southern Plateau.					**59.4**	**0.0**							**50**	**10.87**	**−0.33**									**3.2**	
El Paso	3,762	26.18	29.91	+.02	64.5	+1.6	102	77	12	52	90	36	45	8.41	−1.43	51	84,920	nw.	50	sw.	187	132	46	3.6	8.8
Santa Fe	7,013	23.27	29.96	+.08	48.9	+0.1	87	61	5	37	82	31	57	15.15	+0.66	98	68,036	ne.	38	sw.	205	121	39	3.4	39.6
Flagstaff	6,907	23.37	29.93	+.02	45.3	+0.6	88	59	−10	32	98	29	64	25.02	+2.06	98	64,681	sw.	39	sw.	155	100	110	4.7	76.4
Phoenix	1,108	28.76	29.90	+.02	69.6	+0.2	117	83	30	56	87	41	44	8.17	+0.30	47	36,273	e.	36	e.	200	136	29	3.3	
Yuma	141	29.75	29.90	+.02	71.1	−1.0	114	86	34	57	80	45	46	2.61	−0.49	13	54,214	w.	41	w.	302	47	16	1.4	
Independence	3,910	29.97	29.94	+.01	56.8	−1.7	96	44	11	57	85	31	46	5.85	−3.68	24	60,902	nw.	44	se.	255	62	48	2.9	13.4
Middle Plateau.					**50.2**	**+1.1**							**56**	**12.89**	**+1.42**									**4.5**	
Reno	4,532	25.46	29.99	.00	49.9	+0.8	96	63	−4	36	100	32	61	11.27	+0.84	66	47,383	w.	48	sw.	182	120	63	4.0	52.2
Winnemucca	4,344	25.61	30.00	−.01	49.5	+0.7	96	64	−5	36	101	32	59	11.65	+3.25	89	57,475	sw.	47	sw.	183	78	104	4.2	52.9
Modena	5,479	24.61	29.95	.00	48.3	−0.2	92	62	−8	34	100	30	59	12.80	+2.65	74	96,506	w.	58	sw.	129	112	124	5.1	39.4
Salt Lake City	4,366	25.61	29.97	−.02	52.3	+0.5	95	62	10	43	85	34	55	19.22	+3.19	111	53,249	se.	64	w.	155	89	121	4.8	64.2
Durango	6,546	23.67	29.97	+.03	47.3	+0.3	91	61	−9	33	100	29	60	20.66	+4.00	112	48,917	nw.	38	s.	112	153	100	5.1	44.8
Grand Junction	4,608	25.38	29.96	.00	54.1	+1.6	98	66	4	42	94	31	51	9.41	+0.91	76	44,024	e.	34	sw.	162	98	106	4.5	12.9
Northern Plateau.					**49.4**	**+0.6**							**62**	**15.27**	**+1.04**									**5.3**	
Baker City	3,471	26.43	30.03	−.01	46.7	+2.1	95	57	−2	36	97	32	63	10.90	−2.30	108	56,047	s.	34	s.	127	124	114	5.0	55.4
Boise	2,739	27.16	30.02	−.02	52.0	+1.4	100	62	13	41	87	34	56	15.92	+3.21	105	47,953	se.	35	nw.	131	102	132	5.3	21.0
Lewiston	757	29.20	30.02	+.01	52.4	−0.8	106	63	−2	42	108	.....	.....	14.43	+0.95	102	44,261	e.	62	w.	103	100	162	5.7	33.4
Pocatello	4,477	25.48	30.02	.00	48.1	+0.5	94	59	−5	37	99	31	60	17.43	+4.50	118	72,277	se.	40	w.	150	137	69	4.2	44.5
Spokane	1,929	27.96	30.02	.00	47.6	−0.2	97	57	−3	38	100	35	67	17.69	−1.16	106	52,205	s.	40	sw.	74	140	151	6.3	44.2
N. Pac. Coast Region.					**50.5**	**+0.5**							**79**	**40.57**	**−7.63**									**6.5**	
North Head	211	29.80	30.02	−.02	50.2	+0.3	87	54	17	46	70	46	86	39.93	−5.84	153	141,478	se.	96	se.	84	101	180	6.4	1.0
Port Crescent	259	29.74	30.02	+.01	45.8	−0.4	89	53	8	39	81	.....	.....	35.31	−6.92	135	47,425	se.	44	ne.	94	94	177	6.2	14.2
Seattle	123	29.91	30.04	+.02	51.1	+0.3	91	58	11	44	80	43	78	29.10	−6.49	130	70,443	s.	58	s.	72	127	166	6.6	16.0
Takoma	213	29.80	30.03	.00	50.9	+0.5	92	58	9	44	83	.....	.....	33.48	−11.93	131	51,766	sw.	48	sw.	85	91	189	6.6	16.4
Tatoosh Island	86	29.90	30.00	.00	48.3	+0.2	74	54	21	44	53	44	84	61.13	−27.65	171	142,406	e.	82	sw.	74	62	229	7.1	9.8
Portland, Oreg.	153	29.87	30.03	−.02	53.6	+1.2	102	61	13	46	89	44	73	42.89	−2.24	133	56,995	nw.	40	s.	111	111	143	5.6	6.5
Roseburg	510	29.48	30.03	−.03	53.7	+1.1	100	65	18	43	82	44	76	42.12	+7.69	138	26,126	n.	22	nw.	124	112	129	5.4	4.4
Mid. Pac. Coast Region.					**57.3**	**0.0**							**73**	**27.29**	**+1.47**									**5.4**	
Eureka	62	29.99	30.06	−.01	52.3	+1.0	70	57	33	48	37	48	85	54.11	+8.06	140	55,370	nw.	45	sw.	49	145	171	6.7	6.9
Mount Tamalpais	2,375	27.55	30.03	.00	54.0	.....	88	60	28	48	60	40	68	30.95	+8.15	105	139,329	nw.	78	sw.	180	58	127	4.5	27.0
Red Bluff	332	29.62	29.97	−.04	61.2	−1.3	101	72	27	51	74	45	63	24.63	−0.40	85	46,557	se.	32	se.	149	84	132	5.0	1.4
Sacramento	69	29.92	29.99	.00	59.6	0.0	99	69	31	50	68	47	68	20.05	−0.04	69	73,018	s.	44	se.	208	67	90	3.8	T.
San Francisco	155	29.86	30.03	+.01	56.0	+1.1	90	62	36	50	54	48	80	22.47	+0.20	80	69,843	w.	42	sw.	110	143	112	5.2	
S. Pac. Coast Region.					**61.2**	**+0.8**							**70**	**14.34**	**+0.35**									**4.0**	
Fresno	330	29.64	29.99	+.02	62.5	−0.7	103	75	30	50	73	43	58	9.00	−0.73	47	45,076	nw.	26	sw.	227	36	102	3.8	
Los Angeles	338	29.62	29.99	+.01	62.6	+2.3	103	72	35	53	68	49	71	15.30	−0.34	56	45,780	w.	34	sw.	158	107	100	4.5	
San Diego	87	29.80	29.98	.00	61.4	+0.8	86	68	35	55	51	52	75	7.95	−2.06	54	50,413	nw.	33	nw.	280	51	34	2.9	
San Luis Obispo	201	29.82	30.03	+.01	58.2	+1.0	96	68	30	48	66	48	76	25.13	+4.52	66	46,217	nw.	25	s.	156	109	100	4.7	
West Indies.																									
San Juan	82	29.91	30.00	+.01	77.7	−1.0	92	83	63	72	29	70	78	52.03	−2.48	226	95,316	e.	38	ne.	171	144	59	4.0	

*Pressure reduced to standard gravity and to the mean of 24 hourly observations. †For the snow year, July 1, 1906, to June 30, 1907.

TABLE II.—*Wind resultants, from observations at 8 a. m. and 8 p. m., daily, during the year 1907.*

Stations.	Component direction from— N.	S.	E.	W.	Resultant. Direction from—	Duration.
	Hours.	*Hours.*	*Hours.*	*Hours.*	°	*Hours.*
New England.						
Eastport, Me	206	251	106	316	s. 78 w.	214
Portland, Me	239	222	99	336	n. 85 w.	241
Concord, N. H. †	157	90	83	129	n. 34 w.	81
Burlington, Vt. †	83	168	79	100	s. 14 w.	88
Boston, Mass	199	205	112	358	s. 89 w.	246
Nantucket, Mass	201	246	141	323	s. 76 w.	185
Block Island, R. I	214	243	130	334	s. 82 w.	206
Providence, R. I	221	187	123	359	n. 76 w.	247
Hartford, Conn	283	263	63	265	n. 84 w.	202
New Haven, Conn	296	207	135	261	n. 55 w.	158
Middle Atlantic States.						
Albany, N. Y	247	295	76	231	s. 77 w.	159
Binghamton, N. Y. †	120	52	132	142	n. 8 w.	69
New York, N. Y	225	218	136	305	n. 88 w.	169
Harrisburg, Pa	226	160	185	266	n. 51 w.	104
Philadelphia, Pa	277	215	150	276	n. 65 w.	143
Scranton, Pa	251	238	157	279	n. 81 w.	122
Atlantic City, N. J	255	222	122	300	n. 79 w.	176
Baltimore, Md	268	167	144	300	n. 57 w.	176
Washington, D. C	302	197	163	244	n. 38 w.	132
Lynchburg, Va	223	205	183	280	n. 79 w.	99
Norfolk, Va	236	287	189	163	s. 27 e.	58
Richmond, Va	255	285	175	152	s. 37 e.	38
Wytheville, Va	157	111	152	430	n. 80 w.	284
South Atlantic States.						
Asheville, N. C	326	217	183	184	n.	109
Charlotte, N. C	203	264	227	206	s. 19 e.	64
Hatteras, N. C	261	191	211	262	n. 36 w.	86
Raleigh, N. C	248	230	139	269	n. 81 w.	132
Wilmington, N. C	238	225	173	264	n. 84 w.	91
Charleston, S. C	207	247	177	253	s. 62 w.	86
Columbia, S. C	220	232	200	242	s. 74 w.	44
Augusta, Ga	209	241	185	254	s. 65 w.	68
Savannah, Ga	196	231	149	286	s. 74 w.	146
Jacksonville, Fla	327	260	215	307	n. 52 w.	114
Florida Peninsula.						
Jupiter, Fla	162	259	248	230	s. 11 e.	102
Key West, Fla	254	149	416	78	n. 74 e.	354
Tampa, Fla	271	149	260	233	n. 14 e.	124
Eastern Gulf States.						
Atlanta, Ga	222	188	195	292	n. 70 w.	102
Macon, Ga. †	130	100	72	130	n. 62 w.	65
Thomasville, Ga	186	268	208	208	s.	82
Pensacola, Fla. †	168	67	112	101	n. 6 e.	101
Anniston, Ala	235	292	196	147	s. 41 e.	74
Birmingham, Ala	249	216	193	223	n. 42 w.	45
Mobile, Ala	270	273	163	169	s. 63 w.	7
Montgomery, Ala	211	231	199	232	s. 59 w.	39
Meridian, Miss	226	233	200	239	s. 80 w.	40
Vicksburg, Miss	198	272	250	176	s. 45 e.	105
New Orleans, La	219	278	227	158	s. 49 e.	92
Western Gulf States.						
Shreveport, La	183	312	286	127	s. 51 e.	206
Bentonville, Ark. †	95	175	104	60	s. 29 e.	91
Fort Smith, Ark	145	192	351	148	s. 76 e.	206
Little Rock, Ark	213	269	209	195	s. 14 e.	58
Corpus Christi, Tex	185	346	318	50	s. 59 e.	312
Fort Worth, Tex	170	351	224	152	s. 22 e.	193
Galveston, Tex	171	335	288	92	s. 51 e.	256
Palestine, Tex	195	343	205	121	s. 30 e.	170
San Antonio, Tex	197	293	393	52	s. 74 e.	354
Taylor, Tex. †	100	186	58	70	s. 8 w.	87
Ohio Valley and Tennessee.						
Chattanooga, Tenn	231	252	259	268	s. 23 w.	23
Knoxville, Tenn	270	213	183	261	n. 54 w.	96
Memphis, Tenn	222	283	217	181	s. 31 e.	70
Nashville, Tenn	217	212	194	266	n. 85 w.	72
Lexington, Ky. †	74	147	98	125	s. 21 w.	77
Louisville, Ky	220	273	157	232	s. 55 w.	90
Evansville, Ind. †	133	119	106	86	n. 55 e.	24
Indianapolis, Ind	234	266	203	201	s. 4 e.	32
Cincinnati, Ohio	215	206	236	267	n. 74 w.	32
Columbus, Ohio	205	250	185	260	s. 59 w.	88
Pittsburg, Pa	264	204	107	342	s. 76 w.	247
Parkersburg, W. Va	224	254	142	255	s. 75 w.	114
Elkins, W. Va	228	203	97	304	n. 83 w.	206
Lower Lake Region.						
Buffalo, N. Y	158	234	149	340	s. 69 w.	205
Canton, N. Y. †	72	121	76	186	s. 66 w.	121
Oswego, N. Y	179	303	116	260	s. 49 w.	190
Rochester, N. Y	131	249	119	403	s. 67 w.	305
Syracuse, N. Y	136	293	127	302	s. 48 w.	241
Erie, Pa	153	264	149	304	s. 55 w.	190
Cleveland, Ohio	177	300	200	230	s. 14 w.	127
Sandusky, Ohio †	73	128	75	167	s. 59 w.	106
Toledo, Ohio	198	248	130	328	s. 76 w.	206
Detroit, Mich	181	215	161	320	s. 78 w.	164
Upper Lake Region.						
Alpena, Mich	241	218	129	310	n. 83 w.	182
Escanaba, Mich	279	222	131	258	n. 65 w.	143
Grand Haven, Mich	223	226	181	255	s. 88 w.	75
Grand Rapids, Mich	223	222	163	269	w.	106
Houghton, Mich. †	101	43	144	145	s. 89 w.	58
Marquette, Mich	238	194	132	332	n. 78 w.	205
Port Huron, Mich	215	256	147	286	s. 74 w.	146
Sault Sainte Marie, Mich	211	167	238	290	n. 50 w.	68
Chicago, Ill	214	229	164	307	s. 84 w.	144
Milwaukee, Wis	215	196	150	321	n. 83 w.	171
Upper Lake Region—Continued.						
Green Bay, Wis	198	266	153	286	s. 62 w.	148
Duluth, Minn	282	114	173	353	n. 47 w.	246
North Dakota.						
Moorhead, Minn	292	234	146	228	n. 55 w.	100
Bismarck, N. Dak	313	154	185	264	n. 27 w.	178
Devils Lake, N. Dak	211	219	174	292	s. 86 w.	117
Williston, N. Dak	261	214	169	259	n. 62 w.	102
Upper Mississippi Valley.						
Minneapolis, Minn. *	112	110	78	143	n. 88 w.	65
St. Paul, Minn	266	230	192	208	n. 24 w.	39
La Crosse, Wis. †	117	159	50	85	s. 40 w.	55
Madison, Wis	222	256	149	280	s. 76 w.	136
Charles City, Iowa	264	229	175	253	n. 66 w.	86
Davenport, Iowa	232	189	192	281	n. 63 w.	98
Des Moines, Iowa	239	258	165	245	s. 76 w.	82
Dubuque, Iowa	261	235	118	276	n. 81 w.	159
Keokuk, Iowa	234	245	183	241	s. 78 w.	59
Cairo, Ill	254	268	194	173	s. 56 e.	25
La Salle, Ill. †	109	91	108	134	n. 55 w.	32
Peoria, Ill	228	269	170	209	s. 44 w.	57
Springfield, Ill	209	262	176	232	s. 47 w.	76
Hannibal, Mo. †	116	110	78	153	n. 85 w.	75
St. Louis, Mo	201	270	217	200	s. 16 e.	73
Missouri Valley.						
Columbia, Mo. *	105	123	116	101	s. 40 e.	23
Kansas City, Mo	221	294	208	162	s. 32 e.	85
Springfield, Mo	196	310	223	163	s. 29 e.	125
Iola, Kans. †	102	142	118	83	s. 41 e.	53
Topeka, Kans. *	115	159	126	61	s. 56 e.	78
Lincoln, Nebr	263	281	207	125	s. 78 e.	84
Omaha, Nebr	270	257	170	191	n. 59 w.	25
Valentine, Nebr	280	179	155	261	n. 48 w.	149
Sioux City, Iowa †	136	122	109	90	n. 54 e.	24
Pierre, S. Dak	256	168	303	206	n. 48 e.	130
Huron, S. Dak	284	230	209	185	n. 24 e.	59
Yankton, S. Dak. †	112	95	92	149	n. 72 w.	63
Northern Slope.						
Havre, Mont	209	113	218	336	n. 50 w.	16
Miles City, Mont	276	215	232	181	n. 40 e.	78
Helena, Mont	152	227	61	464	s. 79 w.	408
Kalispell, Mont	144	175	73	435	s. 85 w.	362
Cheyenne, Wyo	282	187	80	339	n. 70 w.	276
Lander, Wyo	231	216	158	304	n. 86 w.	148
Yellowstone Park, Wyo	154	402	47	319	s. 47 w.	368
North Platte, Nebr	233	221	225	209	n. 53 e.	20
Middle Slope.						
Denver, Colo	248	311	130	170	s. 32 w.	65
Pueblo, Colo	265	164	230	261	n. 17 w.	104
Concordia, Kans	210	292	195	157	s. 25 e.	90
Dodge, Kans	215	254	287	158	s. 73 e.	135
Wichita, Kans	230	313	232	127	s. 51 e.	128
Oklahoma, Okla	223	118	133	79	n. 27 e.	118
Southern Slope.						
Abilene, Tex	186	404	162	116	s. 21 w.	128
Amarillo, Tex	150	391	161	135	s. 6 e.	186
Del Rio, Tex. †	74	84	233	55	s. 87 e.	180
Roswell, N. Mex	245	243	146	229	n. 88 w.	73
Southern Plateau.						
El Paso, Tex	243	78	242	331	n. 29 w.	188
Santa Fe, N. Mex	287	178	310	152	n. 56 e.	19
Flagstaff, Ariz	232	203	99	358	n. 83 w.	262
Phoenix, Ariz	148	136	336	237	n. 83 e.	100
Yuma, Ariz	224	196	178	284	n. 75 w.	114
Independence, Cal	234	266	203	201	s. 4 e.	32
Middle Plateau.						
Reno, Nev	97	181	116	453	s. 75 w.	352
Tonopah, Nev	110	289	244	293	s. 16 w.	187
Winnemucca, Nev	220	216	195	323	n. 88 w.	128
Modena, Utah	96	187	115	466	s. 76 w.	361
Salt Lake City, Utah	195	275	279	184	s. 50 e.	124
Durango, Colo	337	124	72	393	n. 56 w.	383
Grand Junction, Colo	183	188	260	270	s. 63 w.	11
Northern Plateau.						
Baker City, Oreg	194	364	144	186	s. 14 w.	175
Boise, Idaho	239	213	219	250	n. 50 w.	40
Lewiston, Idaho †	25	84	258	41	s. 75 e.	228
Pocatello, Idaho	78	335	243	271	s. 7 w.	262
Spokane, Wash	213	270	197	200	s. 3 w.	57
North Pacific Coast Region.						
North Head, Wash	248	216	198	257	n. 62 w.	68
Port Crescent, Wash. *	104	87	96	175	n. 76 w.	82
Seattle, Wash	242	263	225	144	s. 75 e.	84
Tacoma, Wash	266	247	106	261	n. 83 w.	161
Tatoosh Island, Wash	78	283	256	233	s. 6 e.	205
Portland, Oreg	250	247	172	235	n. 87 w.	54
Roseburg, Oreg	271	200	149	241	n. 52 w.	114
Middle Pacific Coast Region.						
Eureka, Cal	257	241	135	248	n. 83 w.	116
Mount Tamalpais, Cal	246	159	84	416	n. 75 w.	342
Red Bluff, Cal	229	299	200	212	s. 16 w.	71
Sacramento, Cal	132	429	197	131	s. 13 e.	308
San Francisco, Cal	127	176	52	491	s. 84 w.	443
San Jose, Cal. †	189	50	31	220	n. 54 w.	236
Southeast Farallon, Cal. *	169	84	22	203	n. 66 w.	197
South Pacific Coast Region.						
Fresno, Cal	299	123	138	363	n. 52 w.	292
Los Angeles, Cal	184	153	215	337	n. 76 w.	124
San Diego, Cal	297	119	137	341	n. 48 w.	269
San Luis Obispo, Cal	329	138	74	312	n. 51 w.	306

* From observations at 8 p. m. only. † From observations at 8 a. m. only.

TABLE III.—*Total number of days with thunderstorms at selected stations, 1907.*

States and stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Alabama.													
Anniston	1	2	1	8	11	10	16	12	6	1	1	5	74
Birmingham	3	1	2	5	10	8	12	12	7	1	0	4	65
Mobile	0	3	3	5	9	14	18	21	8	1	1	4	87
Montgomery	0	1	2	5	11	10	11	8	4	2	3	1	58
Scottsboro	0	0	0	0	1	1	6	0	0	0	1	0	9
Arizona.													
Flagstaff	0	1	1	3	4	6	16	17	8	7	0	0	63
Phoenix	1	1	0	2	2	2	10	10	5	4	1	0	38
Pinto	4	0	3	2	0	1	3	10	2	2	1	0	28
Yuma	0	0	1	0	0	0	0	0	0	2	0	0	3
Arkansas.													
Bentonville	3	1	2	7	12	10	5	6	6	2	0	0	54
Little Rock	2	4	4	7	8	9	3	8	3	2	0	0	50
Fort Smith	0	2	4	6	12	11	6	8	4	2	0	0	55
California.													
Eureka	0	0	2	0	0	0	0	0	0	2	0	6	10
Fresno	0	0	0	0	0	1	0	0	0	0	0	0	1
Independence	0	0	0	1	1	3	1	0	1	2	0	0	9
Los Angeles	0	0	2	0	1	1	0	0	0	2	1	0	7
Mount Tamalpais	0	0	0	0	0	0	0	0	0	1	0	0	1
Point Reyes Light	0	0	0	0	0	0	0	0	0	1	0	1	2
Red Bluff	0	0	0	0	0	4	0	0	0	1	0	0	5
Sacramento	0	0	2	0	1	1	0	0	0	1	0	1	6
San Diego	0	0	0	0	0	0	0	0	0	1	0	0	1
San Francisco	0	0	0	0	0	0	0	0	0	1	0	1	2
San Jose	0	1	0	0	0	0	0	0	0	0	0	1	2
San Luis Obispo	0	0	0	0	0	0	0	0	0	0	0	0	0
Southeast Farallon	0	0	0	0	0	0	0	0	0	1	0	0	1
Colorado.													
Denver	0	1	0	1	7	9	12	6	4	1	0	0	41
Durango	0	0	0	3	8	4	14	14	4	0	0	0	47
Grand Junction	0	1	0	1	5	8	6	10	5	1	0	0	37
Pueblo	0	1	0	1	10	6	16	13	5	1	0	0	53
Connecticut.													
Hartford	1	0	1	1	3	4	4	2	5	0	0	1	22
New Haven	1	0	2	1	4	6	4	1	6	0	0	0	25
District of Columbia.													
Washington	0	0	3	2	4	3	9	6	8	2	1	1	39
Florida.													
Jacksonville	0	1	2	4	12	9	23	22	17	1	0	3	94
Jupiter	0	0	0	3	8	11	19	12	14	4	1	2	74
Key West	0	1	0	1	6	14	12	13	14	3	2	2	68
Merritt Island	0	1	0	5	15	18	24	27	27	6	1	1	125
Myers	0	0	0	1	13	23	30	30	30	4	0	0	131
Pensacola	0	3	2	9	11	14	21	23	15	3	2	6	109
Sand Key	0	1	0	2	6	9	10	7	7	2	1	2	47
Tampa	0	2	0	1	11	11	22	23	20	2	1	2	95
Georgia.													
Atlanta	0	0	3	6	9	8	15	14	5	0	2	2	64
Augusta	0	1	2	4	9	8	17	12	9	0	1	0	63
Macon	0	1	2	6	8	7	14	12	8	0	0	1	56
Savannah	0	1	1	4	9	11	19	21	8	1	1	1	77
Thomasville	0	3	2	8	8	9	20	17	15	1	1	3	87
Idaho.													
Boise	0	0	1	2	2	1	4	3	1	1	0	0	15
Chesterfield	0	0	1	1	5	11	7	12	6	3	0	0	46
Lewiston	0	0	1	3	6	2	4	4	2	0	0	0	22
Murray	0	0	0	1	2	3	7	2	1	0	0	0	16
Pocatello	0	0	1	2	1	6	7	8	1	1	0	0	27
Illinois.													
Cairo	3	1	6	3	9	11	9	10	4	3	1	0	60
Chicago	2	0	5	3	5	7	7	7	5	2	0	0	43
Cisne	0	0	3	4	3	6	9	8	4	0	0	2	34
Galva	1	0	3	1	5	6	7	7	3	1	0	0	34
La Salle	2	0	4	3	7	8	16	11	6	1	1	1	60
Peoria	2	0	4	3	7	9	13	12	5	0	0	1	56
Rantoul	4	0	8	4	8	8	12	10	6	1	0	1	62
Springfield	3	0	8	5	8	9	14	10	2	2	0	1	62
Indiana.													
Butlerville	2	0	3	4	0	8	3	2	0	2	1	1	26
Evansville	3	0	5	7	8	10	13	9	6	4	0	1	66
Indianapolis	0	0	6	3	4	11	9	4	4	1	0	2	44
Iowa.													
Charles City	1	0	1	0	6	7	15	6	7	2	0	0	45
Davenport	1	0	3	2	4	9	11	9	6	2	0	0	47
Des Moines	2	0	1	1	5	8	18	9	7	4	0	0	55
Dubuque	1	0	2	1	4	7	13	7	7	3	0	0	45
Keokuk	2	0	4	1	4	11	13	8	6	2	0	1	52
Sioux City	1	0	0	0	7	9	15	9	6	4	0	0	51
Kansas.													
Concordia	0	1	0	0	4	7	7	8	10	1	0	0	38
Dodge	0	0	1	2	2	10	7	6	8	3	0	0	39
Iola	4	0	2	2	5	12	5	6	7	3	0	0	46
Topeka	2	3	6	2	5	9	9	10	8	3	0	1	58
Wichita	1	2	1	2	7	10	7	7	8	3	0	0	48
Kentucky.													
Lexington	3	0	3	4	4	15	10	9	6	0	0	0	54
Louisville	4	0	2	5	5	11	9	5	5	1	1	1	49
Louisiana.													
New Orleans	1	3	3	5	11	12	10	16	8	2	2	5	75
Shreveport	1	3	2	9	10	7	7	7	0	1	2	3	52
Maine.													
Eastport	0	0	0	0	0	5	7	2	0	2	0	0	16
Farmington	0	0	1	0	1	2	4	2	1	0	0	0	11
Orono	0	0	0	0	0	3	6	1	2	0	1	0	13
Portland	0	0	1	0	0	5	7	1	3	0	0	0	17
Maryland.													
Baltimore	1	0	3	2	4	3	11	6	7	1	0	1	39
Grantsville	0	0	1	2	4	7	4	6	2	0	0	0	26
Princess Anne	0	0	0	1	3	1	5	8	4	0	1	0	23
Massachusetts.													
Boston	0	0	0	1	1	2	4	0	5	0	0	0	13

TABLE III.—*Total number of days with thunderstorms, etc.*—Continued.

States and stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Massachusetts—Con.													
Nantucket	2	0	1	3	3	3	7	1	2	0	0	0	22
Michigan.													
Alpena	0	0	3	0	2	7	3	3	4	1	0	0	23
Detroit	2	0	2	2	2	9	5	1	4	2	0	0	29
Escanaba	0	0	2	0	3	9	7	5	0	1	0	0	27
Grand Haven	1	0	5	1	2	8	8	6	3	2	0	0	36
Grand Rapids	2	0	3	2	3	6	8	5	6	3	0	0	38
Houghton	0	0	1	0	2	4	4	3	2	1	0	0	17
Marquette	0	0	3	0	3	8	7	5	1	0	0	0	27
Port Huron	2	0	3	2	2	6	5	3	6	4	0	0	33
Sault Sainte Marie	0	0	2	0	2	2	3	5	3	0	0	0	17
Minnesota.													
Collegeville	0	0	0	0	1	2	2	2	3	0	0	0	10
Duluth	0	0	0	0	2	2	8	6	3	0	0	0	21
Minneapolis	0	0	1	0	3	8	6	6	6	2	0	0	32
Moorhead	0	0	0	0	2	5	8	7	6	1	0	0	29
St. Paul	0	0	1	0	2	9	7	5	4	1	0	0	29
Mississippi.													
Biloxi	1	3	4	2	7	2	5	6	2	1	0	3	36
Meridian	2	4	2	8	9	9	7	16	2	1	0	1	61
Vicksburg	2	4	1	9	11	8	8	9	4	2	1	2	61
Missouri.													
Columbia	4	0	3	5	6	14	13	9	6	2	0	0	62
Hannibal	2	0	6	6	6	10	11	11	4	1	0	1	58
Kansas City	2	0	6	3	5	12	10	10	6	3	0	2	59
St. Louis	0	0	6	4	6	11	8	9	4	3	1	0	52
Springfield	8	1	2	6	10	12	5	5	4	4	0	0	52
Montana.													
Havre	0	0	0	0	2	8	3	4	2	0	0	0	19
Helena	0	0	0	0	3	10	16	8	5	0	0	0	42
Kalispell	0	0	0	0	4	6	9	3	5	0	0	0	27
Miles City	0	0	0	0	2	11	6	3	1	0	0	0	23
Ovando	0	0	1	0	0	0	1	0	0	0	0	0	2
Renova	0	0	0	0	0	0	1	2	0	0	0	0	3
Nebraska.													
Lincoln	0	1	0	1	6	6	12	6	8	4	0	0	44
North Platte	0	0	0	0	10	11	19	10	3	0	0	0	53
Omaha	0	1	0	3	5	9	16	9	6	2	0	0	51
Valentine	0	0	0	1	4	12	17	10	6	1	0	0	51
Nevada.													
Reno	0	0	0	1	3	3	2	4	1	3	0	0	17
Tonopah	0	0	0	1	0	6	1	2	2	0	0	0	12
Winnemucca	0	0	0	2	2	6	2	1	2	2	0	0	17
New Hampshire.													
Concord	0	0	0	0	0	3	5	2	3	0	0	0	13
Nashua	0	0	0	0	0	4	7	0	3	0	1	0	15
New Jersey.													
Atlantic City	0	0	3	2	4	3	8	7	5	3	1	0	33
Cape May	0	0	1	1	5	4	5	4	4	0	2	0	26
Somerville	0	0	1	2	3	3	10	4	6	1	0	1	31
New Mexico.													
Albert	0	0	0	1	4	9	15	14	6	1	0	0	50
Fort Wingate	0	0	0	0	0	0	3	5	0	0	0	0	8
Roswell	0	0	0	0	4	6	6	14	2	4	0	0	36
Santa Fe	0	1	1	2	11	7	25	17	8	2	0	0	74
New York.													
Albany	0	0	3	0	1	7	6	2	5	1	0	0	25
Binghamton	0	0	3	0	2	5	6	3	4	1	0	0	24
Buffalo	2	0	3	0	4	4	7	1	8	1	1	0	31
Canton	0	0	3	2	2	5	5	4	6	1	0	0	28
New York	0	0	1	2	6	2	7	2	7	3	0	0	30
Oswego	0	0	2	1	1	3	7	4	4	2	0	0	24
Rochester	0	0	3	1	1	7	7	5	4	1	0	1	30
South Canisteo	2	0	3	2	1	8	6	5	4	0	0	0	41
Syracuse	0	0	2	1	2	8	8	3	4	2	0	0	30
North Carolina.													
Asheville	0	0	3	5	6	17	13	9	4	0	0	0	57
Brewers	0	0	0	1	3	13	13	8	5	0	1	0	44
Charlotte	0	0	1	4	4	12	16	9	6	1	0	1	54
Hatteras	0	1	2	2	5	7	7	7	8	2	2	0	43
Raleigh	0	0	2	3	8	6	11	5	5	1	1	0	42
Wilmington	0	1	2	3	5	12	14	10	5	0	0	0	52
North Dakota.													
Bismarck	0	0	0	0	2	9	13	7	4	1	0	0	36
Devils Lake	0	0	1	0	0	7	12	10	3	0	0	0	33
Williston	0	0	0	0	2	5	5	5	1	0	0	0	18
Ohio.													
Cincinnati	1	0	2	4	5	8	11	4	5	1	1	0	42
Cleveland	1	0	3	1	4	11	9	1	5	2	0	0	37
Columbus	0	0	4	3	4	11	9	2	4	0	0	0	37
Sandusky	1	0	3	2	3	8	9	3	6	2	0	1	38
Toledo	2	0	4	3	2	11	8	2	7	3	0	1	43
Oklahoma.													
Arapaho	1	1	0	3	7	8	4	0	2	0	0	0	26
Oklahoma	0	1	1	3	5	10	3	4	5	2	0	0	34
Pawhuska	0	1	2	2	3	6	2	2	0	4	0	0	22
Oregon.													
Astoria	0	0	0	0	0	0	0	1	0	0	0	2	3
Baker City	0	0	0	1	5	5	12	1	3	0	0	0	27
Portland	0	0	0	0	0	1	2	1	0	0	0	0	4
Roseburg	0	0	2	0	1	0	1	0	0	0	0	0	4
Pennsylvania.													
Erie	1	0	3	1	4	4	7	3	7	2	0	1	33
Harrisburg	0	0	1	1	1	5	11	4	7	0	0	1	31
Philadelphia	0	0	3	3	6	4	8	5	4	0	0	0	33
Pittsburg	1	1	6	2	5	8	8	2	4	0	0	0	37
Scranton	0	0	2	0	1	7	6	4	4	0	0	1	25
Wellsboro	0	0	3	1	4	6	7	2	3	1	0	1	27
Rhode Island.													
Block Island	1	0	3	4	4	3	2	1	4	0	1	0	23
Narragansett	1	0	1	3	4	1	2	0	0	0	0	0	12
Providence	0	0	0	1	4	2	4	0	6	0	0	0	17
South Carolina.													
Charleston	0	3	2	6	6	12	15	19	9	1	0	1	74

TABLE III.—*Total number of days with thunderstorms, etc.*—Continued.

States and stations.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
South Carolina—Con.													
Columbia	0	1	3	3	8	9	12	12	6	2	1	0	57
South Dakota.													
Huron	0	0	0	0	3	9	12	6	6	0	0	0	36
Pierre	0	0	0	0	5	8	18	9	7	1	0	0	48
Yankton	0	0	1	0	9	10	18	12	4	0	0	0	54
Tennessee.													
Chattanooga	2	0	5	6	8	12	12	13	6	0	4	0	68
Knoxville	0	1	4	4	4	10	9	12	5	1	2	1	53
Memphis	1	2	5	5	5	4	8	5	4	1	1	2	43
Nashville	1	1	4	5	7	7	9	10	3	3	1	1	52
Texas.													
Abilene	2	0	3	2	5	3	3	2	2	1	0	1	24
Amarillo	1	1	0	2	8	5	5	8	3	2	0	0	35
Corpus Christi	0	1	0	2	6	0	6	4	5	0	1	0	25
Del Rio	0	0	1	1	6	1	0	0	0	0	1	0	10
El Paso	0	0	0	1	2	2	6	13	6	4	1	0	35
Fort Worth	1	3	3	5	11	7	6	4	4	5	2	1	52
Galveston	0	1	2	5	8	0	2	8	7	5	5	2	45
Palestine	2	4	2	8	9	9	8	4	7	5	2	2	62
San Antonio	0	1	4	9	9	1	5	4	3	1	4	0	41
Taylor	1	1	3	8	12	0	6	4	5	3	4	2	49
Utah.													
Levan	0	0	0	3	4	7	9	8	2	1	0	0	34
Modena	0	0	1	2	4	3	6	11	2	1	0	0	30
Salt Lake City	1	2	1	6	6	8	9	9	3	5	0	0	50
Vermont.													
Burlington	0	0	2	0	0	8	8	4	3	0	0	0	25
Northfield	0	0	0	0	1	5	7	4	4	0	0	0	23
Jacksonville	0	0	2	0	0	6	7	1	2	0	0	0	18
Virginia.													
Cape Henry	0	1	4	3	7	11	11	6	6	1	1	1	52
Dale Enterprise	1	0	3	2	8	12	11	6	8	0	0	0	51
Lynchburg	0	0	2	3	3	7	9	3	5	0	0	0	32
Mount Weather	0	0	2	1	5	5	9	6	7	0	0	2	37
Norfolk	0	1	2	3	6	8	9	8	5	0	1	1	44
Richmond	0	0	2	2	7	6	8	8	7	1	0	0	41
Wytheville	0	0	4	2	4	12	9	4	4	0	0	0	39
Washington.													
North Head	0	0	0	0	0	0	1	0	0	0	0	1	2
Port Crescent	0	0	0	0	0	0	1	0	0	0	0	0	1
Seattle	0	0	0	0	1	1	2	1	1	0	0	0	6
Spokane	0	0	0	2	4	0	4	3	1	0	0	0	14
Tacoma	0	0	0	0	2	1	3	3	1	0	0	0	10
Tatoosh Island	0	0	0	0	0	0	2	0	0	0	1	0	3
Walla Walla	0	0	0	0	2	0	.....	2	1	0	0	0	.....
West Virginia.													
Elkins	1	0	3	2	7	11	11	8	6	0	0	2	51
Parkersburg	1	0	5	2	7	10	13	4	8	1	0	0	51
Upper Tract	0	0	4	2	3	13	11	5	5	0	0	0	43
Wisconsin.													
Green Bay	0	0	2	0	3	5	8	7	3	1	0	0	29
La Crosse	0	0	2	0	7	6	7	7	8	0	0	0	37
Madison	0	0	3	3	3	9	11	7	7	1	0	0	44
Milwaukee	1	0	3	4	3	9	8	5	4	3	0	0	40
Wyoming.													
Cheyenne	0	0	0	0	7	10	17	15	6	0	0	0	55
Griggs	0	0	0	0	6	16	9	3	1	0	0	0	35
Lander	0	0	0	0	1	6	2	4	0	0	0	0	13
Yellowstone Park	0	0	0	0	3	13	14	7	5	1	0	0	40

TABLE IV.—*Annual climatological summary, Canadian stations, 1907.*

Stations.	Pressure.*			Temperature.				Precipitation.		Total depth of snowfall.†
	Mean not reduced.	Mean reduced.	Departure from normal.	Mean.	Departure from normal.	Mean maximum.	Mean minimum.	Total.	Departure from normal.	
	Ins.	*Ins.*	*Ins.*	°	°	°	°	*Ins.*	*Ins.*	*Ins.*
St. Johns, N. F	.....	.....	.....	.....	.....	.....	.....	.....	.....	55.2
Sydney, C. B. I	29.93	29.97	+.03	40.6	−0.7	49.3	31.8	49.94	− 0.34	137.2
Halifax, N. S	29.86	29.97	.00	42.4	−0.4	50.8	34.1	59.94	+ 2.91	87.8
Grand Manan, N. B	29.89	29.94	−.03	42.5	−0.3	49.6	35.4	48.82	+ 1.57	97.4
Yarmouth, N. S	29.90	29.97	−.01	41.8	−1.4	48.5	35.0	42.81	− 7.52	76.2
Charlottetown, P. E. I	29.89	29.93	−.01	40.1	−0.9	47.3	32.9	37.70	− 3.92	117.7
Chatham, N. B	29.90	29.92	−.02	39.2	+0.5	49.6	28.9	49.93	+ 8.64	163.2
Father Point, Que	29.91	29.93	.00	34.4	−0.4	41.8	27.1	39.69	+ 6.70	126.8
Quebec, Que	29.63	29.96	−.02	37.6	−0.6	45.1	30.1	47.57	+ 5.85	132.8
Montreal, Que	29.75	29.96	−.03	41.0	−0.5	48.2	33.7	40.81	− 0.18	129.8
Rockliffe, Ont	29.37	29.99	.00	36.6	−1.6	47.6	25.6	28.62	− 1.84	80.1
Ottawa, Ont	29.68	30.01	+.01	.....	.....	.....	.....	32.29	− 0.31	‡76.1
Kingston, Ont	29.70	30.02	+.01	42.1	−1.0	49.5	34.7	21.83	−10.98	50.4
Toronto, Ont	29.62	30.01	−.01	44.4	+0.2	52.7	36.0	31.42	− 2.30	47.8
White River, Ont	.....	.....	.....	.....	.....	.....	.....	.....	.....	‡113.1
Port Stanley, Ont	29.37	30.02	−.01	43.6	−1.1	51.7	35.6	32.79	− 1.63	47.7
Southampton, Ont	.....	.....	.....	.....	.....	.....	.....	.....	.....	89.8
Parry Sound, Ont	29.29	29.99	−.01	40.5	+0.3	50.6	30.4	39.49	+ 1.22	124.9
Port Arthur, Ont	29.29	30.02	+.02	34.4	0.0	44.2	24.6	23.89	− 0.87	53.8
Winnipeg, Man	29.16	30.02	+.02	33.4	+0.3	44.1	22.8	16.88	− 4.10	76.2
Minnedosa, Man	28.14	30.00	.00	32.0	+0.4	42.8	21.1	16.41	− 0.04	74.8
Regina, Assin	.....	.....	.....	.....	.....	.....	.....	18.41	+ 2.33	57.5
Medicine Hat, Alberta	27.64	29.94	−.02	40.7	+0.4	52.2	29.2	6.86	− 6.94	30.1
Swift Current, Sask	27.39	30.01	+.04	35.8	−1.7	47.2	24.4	13.17	− 2.30	56.7

TABLE IV.—*Annual climatological summary*—Continued.

Stations.	Pressure.*			Temperature.				Precipitation.		Total depth of snowfall.†
	Mean not reduced.	Mean reduced.	Departure from normal.	Mean.	Departure from normal.	Mean maximum.	Mean minimum.	Total.	Departure from normal.	
	Ins.	*Ins.*	*Ins.*	°	°	°	°	*Ins.*	*Ins.*	*Ins.*
Calgary, Alberta	26.38	29.96	+.03	37.0	−0.2	48.4	.....	14.96	+ 0.09	39.1
Banff, Alberta	.....	.....	.....	.....	.....	.....	.....	23.58	+ 1.67	73.8
Edmonton, Alberta	27.62	29.95	+.02	34.2	−1.4	.....	.....	.....	.....	‡92.3
Prince Albert, Sask	.....	.....	.....	.....	.....	.....	.....	.....	.....	61.1
Battleford, Sask	28.20	29.98	+.01	32.2	−0.5	43.8	20.5	10.11	− 3.82	27.5
Kamloops, B. C	.....	.....	.....	.....	.....	.....	.....	9.23	− 2.40	56.2
Victoria, B. C	.....	.....	.....	.....	.....	.....	.....	22.54	−15.60	5.9
Barkerville, B. C	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hamilton, Bermuda	29.97	30.13	+.04	69.9	+0.2	74.8	65.0	45.36	−16.55	.....

* Pressure reduced to standard gravity and to the mean of 24 hourly observations. † For the snow year, July 1, 1906, to June 30, 1907. ‡ One month's precipitation estimated.

TABLE V.—*Heights of rivers referred to zeros of gages, 1907.*

Stations.	Highest water.		Lowest water.		Annual range.
	Stage.	Date.	Stage.	Date.	
Republican River.	*Feet.*		*Feet.*		*Feet.*
Clay Center, Kans	11.0	Oct. 4	4.8	Sept. 26–30	6.2
Smoky Hill–Kansas River.					
Abilene, Kans	8.7	July 1	0.0	*	8.7
Kansas River.					
Manhattan, Kans	11.5	July 18	2.4	Sept. 21, 27	9.1
Topeka, Kans	12.2	July 20	4.9	Sept. 21–23	7.3
Missouri River.					
Bismarck, N. Dak	12.2	June 29	1.2	Nov. 16	11.0
Pierre, S. Dak. (77)	10.0	July 1	−0.9	Nov. 24	10.9
Sioux City, Iowa	15.2	May 30	2.4	Dec. 28	12.8
Blair, Nebr	13.9	May 31	2.4	Dec. 27, 30	11.5
Omaha, Nebr. (9)	17.6	May 31, June 1	7.0	Nov. 30	10.6
St. Joseph, Mo	13.6	July 20	−1.6	Dec. 27, 28, 31	15.2
Kansas City, Mo	23.5	July 20	3.8	Jan. 29	19.7
Glasgow, Mo	19.6	June 22	1.9	Feb. 8	17.7
Boonville, Mo	22.2	July 23	5.8	Dec. 31	16.4
Hermann, Mo	19.5	July 23, 24	4.9	Dec. 28, 29	14.6
Minnesota River.					
Mankato, Minn	13.6	June 21, 22	1.6	Dec. 28–30	12.0
St. Croix River.					
Stillwater, Minn. (100)	13.7	Apr. 6	3.5	Dec. 1, 2	10.2
Illinois River.					
La Salle, Ill	28.6	Jan. 21	13.3	Nov. 18–20	15.3
Peoria, Ill	20.4	Jan. 24, 25	9.8	Nov. 21	10.6
Conemaugh River.					
Johnstown, Pa	18.0	Mar. 14	0.8	Aug. 22	17.2
Allegheny River.					
Warren, Pa	7.8	Dec. 24	−0.6	Sept. 8	8.4
Parker, Pa	18.0	Mar. 14	0.0	Sept. 1	18.0
Freeport, Pa	28.0	Mar. 15	0.7	Aug. 22	27.3
Youghiogheny River.					
Confluence, Pa	18.6	Mar. 14	0.2	Oct. 24	18.4
West Newton, Pa	28.2	Mar. 14	0.2	Aug. 23, Oct. 26, 27	28.0
Monongahela River.					
Fairmont, W. Va	30.7	Jan. 17	13.5	Sept. 18	17.2
Greensboro, Pa	31.0	Jan. 18	6.8	Oct. 26, 27	24.2
Lock No. 4, Pa	37.4	Mar. 14	6.4	Aug. 21, 23	31.0
Muskingum River.					
Zanesville, Ohio	30.4	Mar. 14	7.8	Sept. 28	22.6
Little Kanawha River.					
Creston, W. Va	22.0	Jan. 13	2.0	Aug. 16	20.0
New–Great Kanawha River.					
Hinton, W. Va	13.0	June 14	1.2	Aug. 19, Sept. 4, 5	11.8
Charleston, W. Va	33.0	June 14	4.0	Aug. 31, Nov. 18	29.0
Scioto River.					
Columbus, Ohio (35)	19.0	Mar. 14	1.4	Sept. 6–17	17.6
Licking River.					
Falmouth, Ky	28.5	Jan. 17	0.5	Oct. 25–27, 30, Nov. 1	28.0
Kentucky River.					
Beattyville, Ky	28.5	Jan. 20	0.1	Oct. 7, 18, 20, 23–26	28.4
Frankfort, Ky	29.6	Jan. 21	4.7	Nov. 1	24.9
Wabash River.					
Mount Carmel, Ill	24.5	Jan. 28	1.7	Oct. 3, 4	22.8
Cumberland River.					
Burnside, Ky	36.0	Mar. 3	−0.1	Aug. 19, Nov. 1	36.1
Celina, Tenn	31.5	Jan. 1, Mar. 4	1.2	Aug. 22, Oct. 26, 27, 29, Nov. 1	30.3
Carthage, Tenn	36.0	Mar. 4	0.9	Oct. 31, Nov. 1	35.1
Nashville, Tenn	38.9	Mar. 3	7.0	Oct. 26	31.9
Clarksville, Tenn	45.3	Mar. 4	1.5	Oct. 28	43.8
Clinch River.					
Speer's Ferry, Va	23.7	June 14	−0.4	Oct. 26	24.1
Clinton, Tenn	25.6	June 16	2.9	Oct. 27, 28	22.7
South Fork of Holston River.					
Bluff City, Tenn	11.7	June 14	0.9	Sept. 7, 17–20, Oct. 26, 27	10.8
Holston River.					
Rogersville, Tenn	14.0	June 15	1.6	Oct. 26, 27	12.4

TABLE V.—*Heights of rivers referred to zeros of gages, 1907*—Continued.

Stations.	Highest water.		Lowest water.		Annual range.
	Stage.	Date.	Stage.	Date.	
French Broad River.	*Feet.*		*Feet.*		*Feet.*
Asheville, N. C.	3.5	Dec. 24	−0.7	Sept. 16, 20, 21, Oct. 23-27, 29-Nov. 2	4.2
Dandridge, Tenn	6.6	Sept. 24	0.5	Sept. 17, 21, Oct. 21-27	6.1
Tennessee River.					
Knoxville, Tenn	12.2	June 16	0.7	Oct. 24-28	11.5
Loudon, Tenn	10.0	June 16	1.0	Oct. 21-27, Nov. 9	9.0
Kingston, Tenn	13.9	June 16	1.3	Sept. 21	12.6
Chattanooga, Tenn	20.8	Jan. 1	2.0	Oct. 21-29, Nov. 2	18.8
Bridgeport, Ala	16.3	Jan. 2	0.6	Oct. 27, 28	15.7
Guntersville, Ala	23.2	Jan. 3	2.1	Oct. 29	21.1
Florence, Ala	14.5	Mar. 5, 6	0.3	Oct. 28-Nov. 1	14.2
Riverton, Ala	24.5	Mar. 5	1.6	Oct. 29	22.9
Johnsonville, Tenn	25.4	Mar. 5	1.4	Nov. 1	24.0
Ohio River.					
Pittsburg, Pa	35.5	Mar. 15	2.8	Sept. 15	32.7
Dam No. 2, Pa	36.8	Mar. 15	0.7	Aug. 23	36.1
Beaver Dam, Pa	47.1	Mar. 15	2.8	Sept. 1	44.3
Wheeling, W. Va	50.1	Mar. 15	2.5	Aug. 24	47.6
Parkersburg, W. Va	51.6	Mar. 16	3.8	Aug. 22, 23	47.8
Point Pleasant, W. Va	54.8	Mar. 18	3.1	Oct. 27, 28	51.7
Huntington, W. Va	58.4	Mar. 18	6.0	Oct. 28, 29	52.4
Catlettsburg, Ky	60.4	Mar. 18	4.6	Oct. 29	55.8
Portsmouth, Ohio	60.9	Jan. 20	5.3	Oct. 29	55.6
Maysville, Ky	60.3	Jan. 21	5.5	Oct. 30	54.8
Cincinnati, Ohio	65.2	Jan. 21	7.0	Oct. 31	58.2
Madison, Ind	56.7	Jan. 22	6.3	Nov. 1, 2	50.4
Louisville, Ky	41.4	Jan. 23	3.4	Nov. 1	38.0
Evansville, Ind	46.2	Jan. 24, 25	5.3	Nov. 1	40.9
Mount Vernon, Ind	48.5	Jan. 26, 27	4.2	Nov. 1	44.3
Paducah, Ky	45.7	Jan. 28	3.6	Nov. 1	42.1
Cairo, Ill	50.4	Jan. 27	9.5	Nov. 1	40.9
Neosho River.					
Iola, Kans	13.1	Jan. 20	−1.5	Sept. 26, 30	14.6
Oswego, Kans	20.8	Jan. 26	0.0	Sept. 23-Oct. 2	20.8
Fort Gibson, Okla	23.5	May 17	8.3	Jan. 2, 3	15.2
Canadian River.					
Calvin, Okla	7.0	Oct. 5	1.7	Sept. 28-30	5.3
Black River.					
Blackrock, Ark	26.0	Jan. 4	2.2	Nov. 1	23.8
White River.					
Calicorock, Ark	35.6	May 7	−0.6	Oct. 22, 23, 28, 31, Nov. 12-17	36.2
Batesville, Ark	33.1	May 8	1.4	Nov. 15-18, Dec. 18-20	31.7
Clarendon, Ark	34.2	May 18	7.3	Oct. 29-Nov. 1, 3-5, 14-17	26.9
Arkansas River.					
Wichita, Kans	2.7	Jan. 20	−2.0	Dec. 4-6, 21	4.7
Tulsa, Okla	12.4	Jan. 22	2.2	Sept. 22, 30	10.2
Webbers Falls, Okla	19.4	Jan. 23	2.0	Nov. 1	17.4
Fort Smith, Ark	19.3	May 17, 18	1.2	Oct. 7	18.1
Dardanelle, Ark	18.8	May 11	1.0	Sept. 17-19	17.8
Little Rock, Ark	21.2	May 11	2.2	Oct. 29, Nov. 7, 19	19.0
Pine Bluff, Ark	23.7	May 12	4.4	Nov. 5-8	19.3
Yazoo River.					
Greenwood, Miss	31.0	June 3-7	1.7	Oct. 29-Nov. 1	29.3
Yazoo City, Miss	26.1	Feb. 14, 15	−1.9	Nov. 6-8	28.0
Ouachita River.					
Camden, Ark	42.0	Jan. 6	3.3	Oct. 5-7	38.7
Monroe, La	38.5	Jan. 23-26	1.8	Sept. 12	36.7
Red River.					
Denison, Tex	12.1	May 27	0.6	Sept. 29	11.5
Fulton, Ark	31.4	June 4	6.5	Sept. 30	24.9
Shreveport, La	26.9	June 13	−1.8	Oct. 3	28.7
Alexandria, La	32.5	June 17, 18	1.6	Oct. 2-7	30.9
Mississippi River.					
Fort Ripley, Minn. (111)	11.8	Mar. 30	4.3	Sept. 9	7.5
St. Paul, Minn. (108)	13.3	Apr. 4	1.3	Dec. 7	12.0
Red Wing, Minn. (76)	10.8	Apr. 6	0.8	Dec. 9-11	10.0
Reeds Landing, Minn. (80)	10.0	Apr. 3, 4	0.1	Dec. 30, 31	9.9
La Crosse, Wis. (80)	11.6	Apr. 4, 5	1.8	Dec. 27, 28	9.8
Prairie du Chien, Wis. (100)	15.0	Apr. 8	3.0	Dec. 3-5	12.0
Dubuque, Iowa ([illegible])	16.1	Apr. 9, 10	1.6	Dec. 23-25	14.5
Leclaire, Iowa (40)	10.5	Apr. 11-13	0.4	Dec. 24-26	10.1
Davenport, Iowa	13.6	Apr. 15	1.8	Dec. 22, 23, 26	11.8
Muscatine, Iowa	14.5	Apr. 13, 14	2.6	Dec. 25-27	11.9
Galland, Iowa	7.4	Apr. 16	0.8	Dec. 24, 25	6.6
Keokuk, Iowa	13.5	July 21	1.1	Dec. 27, 28	12.4
Warsaw, Ill	16.5	July 21	4.0	Dec. 26, 27	12.5
Hannibal, Mo	14.7	July 23	1.9	Dec. 29-31	12.8
Grafton, Ill	18.1	Jan. 23	5.2	Dec. 23, 30, 31	12.9
St. Louis, Mo	28.0	July 25, 26	4.3	Dec. 30	23.7
Chester, Ill	24.0	July 26	4.1	Dec. 13-16	19.9
New Madrid, Mo	39.3	Jan. 28, 29	8.1	Nov. 2, 3	31.2
Luxora, Ark	34.9	Feb. 1, 2	2.6	Nov. 6	32.3
Memphis, Tenn	40.3	Feb. 3	6.6	Nov. 4-7	33.7
Helena, Ark	50.4	Feb. 5, 6	8.9	Nov. 7, 8	41.5
Arkansas City, Ark	52.1	Feb. 8	9.6	Nov. 7-9	42.5
Greenville, Miss	47.3	Feb. 8, 9	7.5	Nov. 7-9	39.8
Vicksburg, Miss	49.7	Feb. 11	6.6	Nov. 9-12	43.1
Natchez, Miss	48.9	Feb. 13, 14	8.6	Nov. 11, 12	40.3
Baton Rouge, La	37.3	Feb. 14-19	4.6	Nov. 14, 15	32.7
Donaldsonville, La	30.1	Feb. 16-19	3.5	Nov. 16	26.6
New Orleans, La	19.8	Feb. 13-21	3.3	Nov. 16	16.5
Atchafalaya River.					
Simmesport, La	42.5	Feb. 19, 20	3.5	Nov. 13, 14	39.0
Melville, La	37.7	Feb. 19, 20	7.6	Nov. 14	30.1
Connecticut River.					
Hartford, Conn. (50)	20.3	Nov. 9	0.7	Aug. 19	19.6
Hudson River.					
Troy, N. Y	18.0	Nov. 8	2.0	Aug. 18, 19	16.0
Albany, N. Y	13.9	Nov. 8	1.2	Sept. 1, 2	12.7

TABLE V.—*Heights of rivers referred to zeros of gages, 1907*—Continued.

Stations.	Highest water.		Lowest water.		Annual range.
	Stage.	Date.	Stage.	Date.	
Delaware River.	*Feet.*		*Feet.*		*Feet.*
Hancock, N. Y. (E. Br.) (a)	10.4	Dec. 11	2.2	Aug. 20*	8.2
Hancock, N. Y. (W. Br.)	10.0	Dec. 11	2.2	Aug. 30, 31*	7.8
Port Jervis, N. Y. (3)	11.4	Dec. 11	−0.4	Aug. 4*	11.8
Phillipsburg, N. J. (45)	18.2	Dec. 11	−0.2	Sept. 2	18.4
Trenton, N. J	10.3	Dec. 12	0.3	Sept. 4	10.0
North Br. Susquehanna River.					
Binghamton, N. Y	12.8	Dec. 11	1.5	Sept. 1	11.3
Wilkes-Barre, Pa	18.7	Dec. 25	2.2	Aug. 29-Sept. 3	16.5
West Br. Susquehanna.					
Williamsport, Pa	16.8	Mar. 15	0.4	Aug. 21-23, 26-Sept. 4	16.4
Susquehanna River.					
Harrisburg, Pa	13.3	Mar. 16	0.5	Sept. 2	12.8
Shenandoah River.					
Riverton, Va	9.0	Apr. 10	−1.6	Oct. 29-Nov. 3	10.6
Potomac River.					
Cumberland, Md	12.0	Mar. 14	1.9	Aug. 22, 23, Oct. 21-27	10.1
Harpers Ferry, W. Va	16.1	Mar. 15	−0.4	Oct. 29-Nov 2	16.5
James River.					
Lynchburg, Va	13.5	Sept. 24	0.8	Aug. 8, 9	12.7
Columbia, Va	28.1	June 2	2.3	Oct. 31-Nov. 2	25.8
Richmond, Va	14.7	June 3	−1.0	Aug. 4	15.7
Roanoke River.					
Clarksville, Va	8.6	June 3	−0.5	Sept. 21, 22, Oct. 14-17, 20-24	9.1
Weldon, N. C	34.0	June 4, Dec. 16	9.0	Sept. 4	25.0
Tar River.					
Greenville, N. C	14.4	June 9	2.8	Sept. 24, Oct. 29, 30	11.6
Haw River.					
Moncure, N. C	19.9	Dec. 15	0.2	Sept. 2	19.7
Cape Fear River.					
Fayetteville, N. C	37.2	Dec. 16	0.7	Oct. 12	36.5
Pedee River.					
Cheraw, S. C	29.1	Dec. 16	1.2	Oct. 27	27.9
Smiths Mills, S. C	14.6	Dec. 25, 26, 31	1.0	Oct. 23, 26, 31	13.6
Lynch Creek.					
Effingham, S. C	10.0	July 5	2.8	Mar. 31, April 1, 15, 16, Nov. 1, 2, 10, 11	7.2
Black River.					
Kingstree, S. C	10.0	Feb. 15	0.4	Oct. 30, 31, Nov. 8, 9	9.6
Catawba-Wateree River.					
Mount Holly, N. C	7.8	Dec. 24	1.8	Jan. 23*	6.0
Catawba, S. C	15.7	Dec. 24	1.2	Oct. 14, 27	14.5
Camden, S. C	29.2	Dec. 25	2.5	Oct. 21	26.7
Congaree River.					
Columbia, S. C	18.7	Dec. 24	0.0	*	18.7
Santee River.					
Rimini, S. C	18.4	Dec. 28, 29	2.9	Oct. 23	15.5
Savannah River.					
Calhoun Falls, S. C	9.3	Dec. 31	2.2	April 8	7.1
Augusta, Ga	28.3	Dec. 24	4.7	Oct. 23	23.6
Oconee River.					
Dublin, Ga	16.1	Dec. 27	−1.4	Sept. 4	17.5
Ocmulgee River.					
Macon, Ga	17.1	Dec. 23	0.1	Sept. 3	17.0
Abbeville, Ga	12.8	Dec. 31	0.5	Sept. 5	12.3
Flint River.					
Montezuma, Ga	14.0	Dec. 27	0.3	Oct. 31, Nov. 1	13.7
Albany, Ga	15.8	Dec. 17	0.5	June 25-Sept. 4, Oct. 29-Nov. 2	15.3
Bainbridge, Ga	16.9	Dec. 31	2.1	June 25-28	14.8
Chattahoochee River.					
Westpoint, Ga	13.0	Mar. 3	1.6	Sept. 1, 21	11.4
Eufaula, Ala	28.0	Dec. 31	0.2	Sept. 23	27.8
Alaga, Ala	26.5	Dec. 25	1.9	Sept. 22, Oct. 21, 24-27, 30, 31, Nov. 2	24.6
Coosa River.					
Rome, Ga	21.6	Mar. 3	0.6	Sept. 20, 21, Oct. 25-29	21.0
Gadsden, Ala	20.2	Mar. 4	0.5	Sept. 19-22	19.7
Lock No. 4, Ala	16.2	Mar. 3, 4	0.4	Sept. 19-21	15.8
Wetumpka, Ala	35.3	Mar. 4	1.5	Oct. 19	33.8
Alabama River.					
Montgomery, Ala	33.8	Mar. 5	0.1	Nov. 6-8	33.7
Selma, Ala	37.5	Mar. 6	0.0	Oct. 25-Nov. 2	37.5
Black Warrior River.					
Tuscaloosa, Ala	50.2	Feb. 2, Mar. 2	4.7	Sept. 1-3, 5	45.5
Tombigbee River.					
Columbus, Miss	16.3	Mar. 6	−3.1	Sept. 13-23, Oct. 5-9, 19-Nov. 1	19.4
Demopolis, Ala	47.3	Mar. 8	−2.0	Nov. 1, 2, 14	49.3
Pascagoula River.					
Merrill, Miss	21.7	May 21	1.3	Oct. 27, 31, Nov. 1	20.4
Pearl River.					
Columbia, Miss	23.2	May 19	3.1	Nov. 14-17	20.1
Sabine River.					
Logansport, La	24.5	May 31	0.1	Sept. 27, 29, 30	24.4
Neches River.					
Beaumont, Tex	10.9	June 2	−0.8	Nov. 13	11.7
Trinity River.					
Dallas, Tex	30.4	June 8	2.8	Sept. 20-22, Oct. 1-4	27.6
Long Lake, Tex	41.0	June 5			
Liberty, Tex	27.4	Nov. 30-Dec. 2	3.5	Sept. 6	23.9
Brazos River.					
Waco, Tex	14.8	Dec. 22	2.4	May 2	12.4
Hempstead, Tex	39.0	Nov. 24	−3.4	April 19, 20	42.4
Booth, Tex	35.3	Nov. 24	2.1	Mar. 22, 23	33.2
Colorado River.					
Austin, Tex	10.2	May 30	0.5	Sept. 8, 9, 13, 14, 17-20	9.7
Columbus, Tex	35.0	May 31	5.1	Sept. 30	29.9
Red River of the North.					
Moorhead, Minn. (96)	29.8	Mar. 30, 31	7.0	Nov. 13, 14	22.8
Snake River.					
Lewiston, Idaho	15.6	May 20	1.4	Sept. 24-26	14.2

TABLE V.—*Heights of rivers referred to zeros of gages, 1907*—Continued.

Stations.	Highest water.		Lowest water.		Annual range.
	Stage.	Date.	Stage.	Date.	
Columbia River.	*Feet.*		*Feet.*		*Feet.*
Wenatchee, Wash.	34.9	June 4; July 5, 6	5.0	Dec. 31	29.9
Umatilla, Oreg.	20.5	June 4	1.7	Dec. 23	18.8
The Dalles, Oreg.	34.1	June 5	1.9	Jan. 16, Dec. 21	32.2
Willamette River.					
Albany, Oreg.	30.7	Feb. 6	0.6	Oct. 23-29	30.1
Portland, Oreg.	22.4	Feb. 8	1.3	Nov. 11	21.1

TABLE V.—*Heights of rivers referred to zeros of gages, 1907*—Continued.

Stations.	Highest water.		Lowest water.		Annual range.
	Stage.	Date.	Stage.	Date.	
Sacramento River.	*Feet.*		*Feet.*		*Feet.*
Red Bluff, Cal.	26.8	Mar. 20	0.9	Nov. 17	25.9
Colusa, Cal.	29.2	Mar. 20	3.3	Sept. and Oct. *	25.9
Knight's Landing, Cal.	20.2	Mar. 21	2.0	Oct. 8-12	18.2
Sacramento, Cal.	27.2	Feb. 7	7.3	Oct. 12, 13	19.9

Figures in parenthesis indicate number of days river was frozen during the year.
(*a*) 38 days missing. * Various dates.

TABLE VI.—*Average monthly and annual departures of temperature from the normal, during 1907.*

Districts.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
New England	− 1.2	− 7.0	+1.5	−3.3	−5.4	−3.0	−0.6	−1.7	+0.7	−3.6	+0.6	+3.7	−1.6
Middle Atlantic	+ 3.4	− 6.2	+4.7	−5.0	−4.4	−4.7	−0.2	−1.2	+1.7	−3.7	−0.2	+2.1	−1.1
South Atlantic	+ 7.0	− 2.8	+7.2	−5.5	−0.9	−2.0	+1.2	+0.8	+2.6	−2.2	−0.6	+0.6	+0.4
Florida Peninsula	+ 5.4	− 0.5	+5.7	−0.9	+1.4	−0.6	+0.3	+0.5	+1.1	−0.9	+1.1	+0.2	+1.1
East Gulf	+ 9.5	+ 0.4	+9.4	−3.9	−2.2	−1.3	+1.1	+1.5	+1.5	+0.1	−1.5	−0.1	+1.2
West Gulf	+10.4	+ 2.8	+9.5	−3.7	−5.0	−0.1	+0.2	+2.5	+2.6	+1.2	−2.1	+1.8	+1.7
Ohio Valley and Tennessee	+ 7.4	− 3.2	+8.8	−7.6	−4.9	−3.5	+0.1	−0.6	+0.7	−2.5	−1.2	+1.2	−0.4
Lower Lakes	+ 1.6	− 5.3	+5.3	−5.4	−7.0	−3.0	−1.5	−2.5	−0.1	−4.2	−0.4	+2.4	−1.7
Upper Lakes	0.0	− 1.4	+5.3	−6.6	−7.5	+0.1	−0.6	−1.6	−0.9	−2.4	+1.0	+1.9	−1.1
North Dakota	+11.4	+ 4.9	+5.0	−8.0	−8.7	−1.2	−1.8	−1.2	−5.0	+1.6	+6.1	+9.1	−0.9
Upper Mississippi Valley	+ 2.4	+ 1.5	+7.9	−7.6	−7.6	−3.2	−0.4	−1.1	−0.9	−1.3	+1.2	+4.3	−0.4
Missouri Valley	+ 0.5	+ 3.6	+9.6	−6.9	−7.1	−2.2	−0.7	+0.6	−0.7	+0.9	+2.6	+5.5	+0.5
Northern Slope	− 5.9	+ 6.4	+4.5	−3.2	−4.8	−3.2	−1.9	−2.8	−1.4	+4.8	+3.4	+2.4	−0.1
Middle Slope	+ 4.2	+ 5.9	+9.5	−5.1	−6.4	−1.2	+0.6	+1.6	+1.2	+1.2	+0.6	+2.7	+1.2
Southern Slope	+ 8.1	+ 6.5	+9.7	−3.9	−6.5	−0.1	−0.2	+2.6	+3.0	0.0	−2.0	+2.0	+1.6
Southern Plateau	+ 2.8	+ 7.0	+1.2	+2.0	−4.7	−5.3	−1.5	−1.0	−0.4	+0.8	−0.2	+2.2	+0.2
Middle Plateau	+ 2.4	+11.2	+2.6	+2.2	−3.5	−5.5	−0.5	−3.1	−0.8	+5.1	+0.1	+3.9	+1.2
Northern Plateau	− 4.7	+ 5.8	+0.9	−0.9	−0.1	−3.0	−0.8	−4.4	−1.1	+5.3	+3.2	+1.9	+0.2
North Pacific	− 4.1	+ 3.1	−1.4	+0.3	+1.6	−0.5	+0.4	−1.4	+1.1	+2.5	+2.6	+1.9	+0.5
Middle Pacific	− 1.3	+ 4.4	−2.9	+1.9	−0.3	−2.1	−1.0	−0.9	−1.7	+1.9	+1.0	+1.1	0.0
South Pacific	− 0.6	+ 5.0	−0.8	+1.6	−0.4	−1.0	+1.4	−1.1	−1.4	+1.9	+2.6	+2.3	+0.8

TABLE VII.—*Monthly and annual departures of precipitation from the normal, during 1907.*

Districts.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
New England	−0.9	−1.2	−1.2	+0.2	−0.3	−0.3	−0.8	−2.4	+3.8	0.0	+1.2	+1.0	− 0.9
Middle Atlantic	−1.4	−1.1	−1.0	−0.2	+0.3	+0.9	−1.4	−1.3	+2.9	−1.0	+1.5	+0.9	− 0.9
South Atlantic	−3.4	−1.2	−2.8	+0.4	+0.4	+0.3	−2.0	−1.1	+1.0	−3.0	+0.4	+1.0	−10.0
Florida Peninsula	−2.5	−2.2	−2.8	+0.7	+2.4	−0.7	+0.1	−2.0	+0.8	−2.6	−0.7	+2.2	− 7.3
East Gulf	−2.6	+0.1	−3.8	+3.2	+3.3	−2.8	−0.1	−1.2	+1.9	−1.7	+2.2	+2.0	+ 0.5
West Gulf	−1.2	−1.4	−1.4	−0.1	+1.9	−1.7	−1.3	−1.9	−1.6	+0.7	+2.8	−0.4	− 5.6
Ohio Valley and Tennessee	+1.9	−2.4	+0.5	−0.8	+0.1	−0.5	−0.8	−0.4	+0.6	−0.2	−0.2	−0.5	− 2.7
Lower Lakes	+1.5	−1.9	+0.3	−0.4	−0.4	−0.2	−0.1	−1.8	+1.5	+0.7	−0.9	+0.9	− 0.8
Upper Lakes	+0.5	−1.3	+0.2	+0.2	−0.8	−0.9	0.0	0.0	+1.6	−1.4	−0.7	−0.3	− 2.9
North Dakota	+0.7	−0.3	−0.1	−1.4	−0.7	−0.5	+0.9	+0.2	+0.4	−0.4	−0.7	−0.3	− 2.2
Upper Mississippi Valley	+1.7	−1.1	0.0	−0.7	−0.9	−0.5	+2.1	+2.2	+0.3	−1.1	−0.6	−0.5	+ 0.9
Missouri Valley	+1.2	−0.2	−0.7	−1.5	−0.6	+0.3	+0.9	−0.8	−0.8	−0.2	−0.5	−0.1	− 3.0
Northern Slope	+0.2	−0.1	−0.3	−0.8	+1.0	+0.3	+0.8	+0.1	+0.1	−0.4	−0.5	−0.3	+ 0.1
Middle Slope	+0.3	−0.2	−0.7	−0.3	−0.6	+0.1	−0.4	−0.2	−0.1	+0.9	−0.5	+0.2	− 1.5
Southern Slope	+0.4	−0.6	−0.4	−0.7	−0.3	+0.7	+0.3	+0.4	−1.8	+1.6	−0.1	+0.1	− 0.4
Southern Plateau	+1.0	−0.4	+0.6	+0.3	+0.2	+0.2	−0.2	+0.9	−0.6	+1.8	−0.4	−0.7	+ 2.7
Middle Plateau	+0.3	0.0	+0.6	0.0	+0.5	+0.4	−0.1	+0.8	−0.3	0.0	−0.6	+0.2	+ 1.8
Northern Plateau	+0.1	+0.4	+0.3	−0.3	−0.4	+0.8	+0.2	+0.8	+0.1	−0.4	−0.6	+0.3	+ 1.3
North Pacific	−1.8	−0.6	−1.8	−0.8	−1.4	−0.8	−0.1	+0.2	−0.1	−2.7	−1.2	+1.1	−10.9
Middle Pacific	+0.8	+0.1	+4.0	−1.6	−1.0	+0.6	0.0	+0.4	−0.4	−0.1	−2.5	+0.2	+ 0.5
South Pacific	+2.8	−1.2	+1.4	−1.0	−0.3	0.0	0.0	0.0	−0.2	+1.0	−1.2	−0.8	+ 0.5

TABLE VIII.—*Monthly and annual departures of relative humidity from the normal, during 1907.*

Districts.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
New England	0	− 3	− 2	+ 1	− 4	− 2	− 3	− 6	+ 3	− 6	− 1	+ 1	− 2
Middle Atlantic	+ 1	− 2	− 2	+ 3	0	+ 3	− 1	− 2	+ 5	− 2	+ 2	+ 2	+ 1
South Atlantic	+ 4	+ 1	− 3	0	+ 2	− 1	− 1	0	+ 2	− 4	0	+ 1	0
Florida Peninsula	− 2	− 2	+ 3	− 1	0	− 3	− 1	− 2	+ 1	− 5	0	0	− 1
East Gulf	+ 4	− 3	− 1	+ 2	+ 7	− 3	− 1	0	+ 4	0	− 3	0	0
West Gulf	+ 4	− 4	+ 2	+ 1	+ 4	− 4	− 1	− 2	− 3	+ 5	− 1	− 1	0
Ohio Valley and Tennessee	+ 2	− 2	− 2	+ 4	+ 3	+ 2	+ 3	+ 3	+ 4	+ 3	− 1	+ 1	+ 2
Lower Lakes	+ 4	− 1	+ 1	+ 2	0	+ 1	+ 3	− 1	+ 6	− 1	+ 1	+ 2	+ 1
Upper Lakes	+ 1	− 3	− 1	− 2	− 2	− 2	+ 1	0	+ 5	− 1	− 3	+ 1	0
North Dakota	+ 6	+ 1	− 3	+ 2	+ 3	+ 2	+ 5	+ 3	+ 9	− 2	− 3	+ 3	+ 2
Upper Mississippi Valley	+ 8	+ 1	+ 1	− 1	+ 1	+ 4	+ 6	+ 7	+ 5	− 1	− 2	+ 2	+ 3
Missouri Valley	+ 6	0	− 4	− 4	0	+ 2	+ 4	− 1	+ 1	− 9	− 8	0	+ 1
Northern Slope	+ 9	+ 3	+ 1	+ 5	+ 8	+ 8	+ 9	+ 7	+10	+ 7	+ 1	+ 7	+ 6
Middle Slope	+ 9	− 5	− 4	+ 3	+ 4	+ 2	+ 2	+ 3	0	+ 9	+ 3	+ 2	+ 2
Southern Slope	+11	− 8	− 1	+ 6	− 1	0	+ 4	− 3	− 4	+13	+14	0	+ 3
Southern Plateau	+17	+10	+ 8	+ 5	+ 7	+ 5	+ 3	+ 5	+ 8	+18	+16	+ 4	+ 9
Middle Plateau	+ 9	+ 2	+ 5	+ 6	+ 5	+11	+ 6	+10	+ 7	+12	+ 8	+ 6	+ 7
Northern Plateau	+ 3	+ 3	+ 4	+ 2	− 6	+ 5	+ 7	+ 3	+ 2	− 3	− 3	− 1	+ 1
North Pacific	− 4	+ 2	+ 1	− 3	0	0	+ 1	+ 1	+ 1	− 4	+ 3	− 1	0
Middle Pacific	+ 2	+ 8	+ 4	+ 1	− 1	+ 5	+ 3	+ 1	+ 3	+ 2	− 2	+ 2	+ 2
South Pacific	+ 7	+ 5	+ 3	+ 2	0	0	− 2	+ 1	+ 3	+ 4	− 1	+ 3	+ 2

TABLE IX.—*Monthly and annual departures of average cloudiness from the normal, during 1907.*

Districts.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
New England	+1.2	−0.3	−0.2	+0.2	+0.8	+0.5	+0.1	−0.1	+1.8	−0.7	+1.0	+0.4	+0.4
Middle Atlantic	+1.0	−0.6	+0.1	+0.7	+0.5	+0.7	−0.2	0.0	+0.8	−1.2	+1.1	+0.7	+0.3
South Atlantic	−1.9	−0.1	−0.3	+0.9	+0.6	−0.3	−0.4	−0.4	−0.1	−0.7	+0.9	+0.4	−0.1
Florida Peninsula	−1.3	−1.3	−1.7	−1.6	−0.5	−1.8	−0.9	−1.2	−1.3	−1.5	−0.2	0.0	−1.1
East Gulf	−0.2	−0.7	−0.3	+0.6	+2.1	−0.3	+0.4	+0.2	+0.9	+0.8	+0.9	+0.8	+0.4
West Gulf	+1.0	−1.0	−0.4	+0.6	+1.2	−0.9	−0.5	−0.7	−0.9	+1.5	+0.5	−0.7	0.0
Ohio Valley and Tennessee	+1.1	0.0	+0.1	+0.6	+0.5	+0.3	0.0	+0.7	+0.5	+0.1	0.0	+1.1	+0.4
Lower Lakes	+0.7	−0.4	+0.5	−1.0	+0.3	+0.1	+0.2	−0.1	+1.9	−0.2	+0.1	+0.4	+0.2
Upper Lakes	+0.9	−0.3	+0.5	−0.9	+0.6	−0.5	+0.2	0.0	+1.8	−0.3	−0.3	+0.3	+0.2
North Dakota	+1.3	−0.4	−0.1	+1.2	+0.7	+0.3	+0.3	+0.7	+0.7	−1.5	−0.4	+0.1	+0.2
Upper Mississippi Valley	+2.2	+0.1	+0.3	+0.2	+0.8	+0.2	+0.4	+0.5	+0.7	−0.2	−1.0	+0.8	+0.4
Missouri Valley	+2.1	−0.2	0.0	+0.6	+0.5	+0.2	−0.1	−0.1	+0.5	−0.5	−0.9	+0.7	+0.2
Northern Slope	+1.3	+0.1	+0.3	+0.7	+0.7	+0.2	+0.1	+0.3	+0.4	−1.4	−0.4	+0.8	+0.3
Middle Slope	+2.3	−0.1	+0.4	+1.6	+0.9	+0.7	0.0	+0.8	+0.8	+1.1	−0.2	+1.2	+0.8
Southern Slope	+1.0	−1.1	+0.3	+0.2	+0.5	−1.0	+0.4	−1.1	−0.2	+3.3	+2.1	−0.4	+0.3
Southern Plateau	+1.5	+0.3	+0.4	−0.6	+0.7	−0.2	−0.1	+0.2	+0.5	+2.4	+0.7	−0.5	+0.4
Middle Plateau	+1.9	+0.6	+1.7	−0.5	+0.7	+0.9	+0.9	+1.7	+0.7	+1.4	−0.2	+0.8	+0.9
Northern Plateau	+0.1	+0.5	+0.6	−1.9	−1.0	+0.6	+0.5	+0.6	+0.2	−2.0	−0.5	+0.6	−0.1
North Pacific	−0.6	+0.1	−0.1	−2.1	+0.1	0.0	+0.1	+1.7	+0.8	+1.0	−0.6	+1.1	+0.1
Middle Pacific	+2.1	+2.5	+1.8	−0.4	+0.7	+1.2	+1.4	+1.2	+0.8	+1.9	+0.1	+2.1	+0.3
South Pacific	+2.3	+1.1	+1.3	−0.1	−0.7	0.0	−0.2	+1.0	−0.1	+1.4	−0.8	+0.1	+0.4

APPENDIX.

ANNUAL REPORT BY WILLIS L. MOORE, CHIEF OF THE WEATHER BUREAU, FOR THE FISCAL YEAR ENDING JUNE 30, 1907.

[Dated November 7. Extract from the report of the Secretary of Agriculture for 1907.]

I have the honor to submit a report of the operations of the Weather Bureau during the fiscal year that ended June 30, 1907.

RESEARCH AT MOUNT WEATHER.

Americans take pride in the pioneer work that Lieutenant Maury, the naval meteorologist, did in studying the geography of the oceans, and in the achievements of Redfield, Espy, Coffin, and Loomis in the gathering of data and the discussion of the theory of storms; all of which pioneer work by Americans led to the establishing of a national weather service. With the information thus acquired the United States has taken the lead in the practical application of meteorological science, which its own students did so much to discover. Until the creation of the research observatory at Mount Weather, however, this country has been in danger of falling behind Germany and France in the further development of the science that is back of the art which is here so successfully applied.

The present may be said to mark an important epoch in the development of meteorological science in this country. A research observatory has been created at Mount Weather, Va., and a staff of highly trained and ambitious young men has been formed. The first important result achieved by this staff was the sending of meteorological instruments by means of aeroplanes to greater altitudes than has to our knowledge been accomplished elsewhere. The observations thus obtained have been continued for over three months in succession, practically without interruption, and it is probable that such record will be maintained indefinitely in the future.

The achievements at this research institution now enable the forecast official at Washington to receive each night the vertical gradients of temperature and the direction of the wind for altitudes on the average from half a mile to two miles and at times over four and one-half miles, and thus to learn something regarding the conflict of currents, their direction and force in the upper regions. These data are of great value in the making of forecasts for the Middle Atlantic and New England States, and for the elucidation of many problems of the upper air that heretofore it has been impossible to study.

For several years Blue Hill Observatory, near Boston, has made a valuable study of thermal and other conditions of the air at considerable altitudes over Boston. The Government, with its greater facilities, is now reaching greater heights and making a more continuous series of observations. All of the uses to which these data will be applied can not now be determined, but it can be definitely stated that for the first time in the history of meteorological science a chart can be presented to students, and especially to the Government forecasters, showing for each day the conditions of the atmosphere at altitudes which so far have never been approached by any captive apparatus that could be safely and expeditiously returned to the hand of the observer. On October 3, 1907, the world's record for the securing of observations high in the air was broken. On that day the meteorological apparatus at Mount Weather reached an altitude of 23,111 feet above sea level.

Heretofore, as is well known, forecasts of the weather have been entirely based on the horizontal gradients of pressure and temperature as measured at the surface of the earth. The addition of a vertical chart for even one station is considered of such importance that the first two charts of this nature, namely, those for the months of July and August, 1907, are herewith produced.[1] They so graphically tell the story of the rise and fall of the thermal levels within their range that the layman is able to comprehend their significance. It is apparent that when a comparatively deep stratum of abnormally warm or abnormally cold air presistently overlies a region, the action of a moving cyclone or anticyclone on the weather experienced at the bottom of the atmosphere will be materially different from that which would be experienced were the upper air at a normal temperature. It is also to be noted that where a reversal of the temperature gradients is shown, as is illustrated several times on the chart for August, a different forecast would be made than if the temperature uniformly and gradually shaded away from the surface upward. The significance of these data, from the viewpoint of the forecaster, are not yet fully comprehended, but certainly they present a fund of information that will be studied with profit by those whose duty it is to add to our limited knowledge of the science that is back of the art of weather forecasting. One method of utilizing the upper air observations made at Mount Weather is illustrated by quoting from the general forecast issued at Washington, at 8 p. m., on October 5, as follows:

> The kite flights at Mount Weather, Va., conducted by the Weather Bureau during the last few days, have shown the beginning of the stronger turbulent circulation of winter. The temperature this afternoon, about 1 mile in the free air above the station was 4° above freezing, with a strong west wind. On October 3 an altitude of slightly over 23,000 feet was reached, at which point a temperature of 5° below zero, F., was recorded.

Still later, the general forecast issued at Washington, at 8 p. m., on October 22, contained the following reference to the observations received from Mount Weather:

> The temperature conditions to-day in the free air above the Weather Bureau Observatory at Mount Weather, Va., were rather unusual, namely, no diminution of temperature up to 1 mile above the station, and only 18° lower on reaching a height of nearly 2 miles above the mountain. The air at the highest point reached had about the same temperature as was recorded at an equal elevation during the past summer, thus indicating, for the present at least, a high degree of heat in the upper regions of the atmosphere.

In view of the success attained in getting flights to considerable elevations on practically every day, it is confidently expected that, with a still further improvement in apparatus, it will be possible to study the march of temperature thru the various seasons of the year at altitudes heretofore inaccessible, as it is probable that eventually heights of 5 to 6 miles will be frequently attained in the making of these observations. It will be extremely interesting to the forecaster to trace the sequence that certainly exist between the temperature changes at these high levels and those that occur at the surface; especially must we determine the altitudes at which both diurnal and annual variations of temperature cease, and whether or not, in regions beyond these two variable strata, there is a constant condition, or whether there are variations in the conditions that control the absorption of heat by the upper air, and the relation of these various phenomena to our weather.

A study of the upper air observations at Mount Weather for a year or two will determine whether or not it is advisable to make kite ascensions at Pikes Peak, Mount Washington, or other elevated places.

Meteorographs and other necessary apparatus are now being made with a view of exploring the various quadrants of

[1] See figs. 1 and 2.

typical storms in the western region. It is proposed to liberate, simultaneously, a large number of free balloons, so constructed as to explode as near as may be at some predetermined altitude—probably 10 miles—the object being to secure data, not for the direct purpose of making weather forecasts, but to explore storms and cold waves, so that more may be learned about the exact operations of nature within these atmospheric vortices.

The upper air work at Mount Weather is especially described because it is the one line of inquiry that, at present, holds out the greatest promise of immediate utility. The results already secured are deemed to be of such value that it is hoped that means will be provided for the diligent prosecution of other lines of research work. When it is considered that about a million and a half of dollars is spent annually in applying, at best, imperfect knowledge of the laws of storms to the agricultural, marine, manufacturing, and commercial industries of this country, it would seem to be a wise economy to maintain experimentation at at least one of the observation stations of the Bureau; in fact, not to do so might be reasonably considered an unpardonable oversight.

The exploration of the upper air is but one of the many problems the elucidation of which must materially add to the value of the Government Weather Service, and it is hoped that Congress will authorize the completion of the physical laboratory building and the cottage-office building, so that the study of the ionization, electrification, and other physical properties of the air may be prosecuted, and that sky polarization, intensity of light, and cloud density may be measured. It is believed that the results attained will be so valuable to meteorological science and the application of that science to the nation's work, that a final building will be constructed which will have to do with the minute analysis and quantitive measurement of the heat in the air as well as the temperature of the air. Preliminary observations along this line have been made by Mr. H. H. Kimball for a number of years. His observations, and those of others, clearly indicate the necessity for a careful study of the problems of atmospheric absorption and the diffusion of light and heat, if ever we are to get a clearer understanding of the fundamental problems of the weather.

Aside from the upper air investigations, research work has been prosecuted during the year along the following lines: (1) solar radiation; (2) magnetism and other smaller problems in solar physics, a brief discussion of which follows:

Solar radiation.—A pyrheliometer and a polarimeter have been installed at Mount Weather, and solar radiation observations begun. Absorption screens designed by Ångström for use in connection with his pyrheliometer have recently been received. These enable us to measure the intensity of the solar radiation in the blue-violet portion of the spectrum, which is practically free from band absorption, but is especially sensitive to variations in the haziness or dustiness of the atmosphere. It is, therefore, believed that these measurements, in connection with determinations of the total radiation, will enable us to differentiate between the effects of atmospheric absorption due to gases, principally water vapor, and the effects of atmospheric diffusion, which latter depends largely upon the number of dust particles present. Computations of the solar constant should then be possible with considerable accuracy.

This work requires auxiliary apparatus of greater sensitiveness than has heretofore been employed in solar radiation work, and Professor Humphreys is already in correspondence with instrument makers relative thereto.

A comparison between the results obtained at Mount Weather and at Washington will be of great interest. If the values of the solar constant computed at the two stations are in accord, the establishment of one or two other pyrheliometer stations, probably in the Southwest, where there is little cloudiness, should enable us to compute the value of the solar constant nearly every day, and with sufficient accuracy to detect any important variations in it. These results will then be studied in connection with the records of the magnetic observatory.

Aside from the computation of the solar constant, the determination of the quantity of solar radiation received at the surface of the earth, and its variations with the seasons and with atmospheric conditions, will be of value. For this purpose, however, a recording pyrheliometer is desired, and as soon as it is decided which one of the types now available is the most satisfactory an instrument will be purchased and installed at Mount Weather.

As a basis for the radiation work that is to be carried on at Mount Weather, Mr. H. H. Kimball will prepare the three following papers for publication in the Mount Weather Bulletin:

(1) Comparisons between different types of pyrheliometers. This will include the extensive series of comparative readings made by Mr. Kimball between the Ångström pyrheliometer and the actinometers in use at the Smithsonian Institution. These comparisons are important, in view of the fact that the international union for cooperation in solar research adopted the Angström instrument as its standard, and especially requests comparisons between this instrument and other types.

(2) Observations with the Ångström pyrheliometer at Washington, D. C.

By the new method of reduction recently pointed out by Ångström we are now able to make better use of these observations than heretofore.

(3) The relation between atmospheric transparency and the polarization of blue skylight.

Mr. Kimball has devoted much time to these problems during the past year and has brought to the work talent of a high order.

Observations with the Ångström pyheliometer and the Pickering polarimeter also have been maintained at the Central Office in Washington thruout the year. The installation of both instruments has been greatly improved, thereby reducing the labor of observing, and the liability of errors in the results. In general the aim has been to obtain observations at noon, and for a sufficient length of time before or after noon, to introduce a variation of at least two atmospheres in the path of the incoming solar radiation, and with intervals between observations equivalent to a change in the length of this path of about 0.05 atmosphere. Observations were made on forty-nine days. On nine of these, however, only short series were obtained; on seven days the series covered the morning hours only; on eighteen days the afternoon hours only; while on twelve days the series of observations extended from early morning until late in the afternoon.

The marked features of the year were the long period from June 25 to October 8, 1906, during which there were no days on which satisfactory observations could be obtained; the unusual transparency of the atmosphere from November 1 to 7, 1907, inclusive; and the low value of the atmospheric transmission factor from April 3, 1907, to the end of the fiscal year.

The two Ångström pyrheliometers of the earlier type of construction, which had been in use since April, 1903, became unservicable, and were replaced by an improved type of this instrument in October, 1906. Unfortunately, direct comparisons between the two types could not be obtained. However, comparisons have been made thru the medium of the actinometers in use at the Astrophysical Observatory of the Smithsonian Institution so that the continuity of the Washington series of actinometer observations has not been impaired.

Sky polarization is being studied in connection with the total radiation received and there appears to be a close connection between them, which is well worth following up, since

doubtless it is connected with the amount of dust, moisture, etc., in the air.

In interpreting pyrheliometric readings with the view of obtaining the solar constant it is necessary to know the moisture content of the atmosphere thruout the path of the solar rays observed, and the simultaneous kite observations will be very useful in this connection.

Considerable time has been devoted to the preparation of plans for a solar physics observatory which it is hoped Congress will authorize to be constructed at Mount Weather. However, no sum for the purpose is included in the estimates of expenses submitted for the coming year, as it is thought to be well to finish the construction and equipment of the physical laboratory before this is begun.

Physics.—Several papers, based upon experimental work of an optical nature, and of value in connection with solar physics have been published. Others are in preparation, and as opportunity offers additional work will be done in meteorological and solar physics; tho of course until the solar and physical laboratories are completed and equipped the range of choice in these fields must be very restricted.

Magnetism.—The routine work of maintaining the self-registering instruments in operation, and making absolute determinations of the magnetic elements at ten day intervals is being carried on in pursuance of the program adopted at the beginning of the year. The adjustment of the instruments is practically complete and probably will not need greatly to be changed in the future.

The determination of the value of the various factors that operate to cause variations in the strength of the magnets used in the magnetometers and magnetographs, thus introducing errors into the indications of the instruments, is going forward, tho more slowly than was anticipated. The delay in completing the physical laboratory has been an especial hindrance as it has deprived us of the apparatus with which it will be equipped, and has thereby compelled the use of slow, laborious, and, as the results show, insufficiently precise methods. Suitable apparatus for these special purposes has therefore been asked for, and this work will be completed on its arrival.

The importance of these constants will be appreciated on realizing that the indications of the magnetic instruments are the result of an interaction between a magnet and the earth, which is itself a great magnet. The variations in the magnetism of the earth would be truly shown if the magnetic strength of the magnetic needle remained constant. This condition is not realized, however, as the magnetic moment of a steel magnet decreases with age; varies inversely with the temperature; and varies with the strength of the earth's field. The law of each of these, and of several more such factors must be discovered for each separate magnet by a series of experiments in which each disturbing force is carried thru a gamut of changes, while all other variables are held constant, or separately observed so that they may be eliminated.

It should be understood that while we are without a satisfactory knowledge of these constants as yet, the observations and records are being made in such form that they can be reduced to absolute measures as soon as the values of the various constants are known.

An intercomparison of the instruments at this observatory with those of the Cheltenham Magnetic Observatory of the United States Coast and Geodetic Survey has been made, and the results now being deduced indicate that, while the absolute values are different, the variations are identical at the two observatories. This indicates that the location of the magnetic observatory at Mount Weather is entirely satisfactory, since it was designed primarily to furnish immediately available data for the study of problems in the dynamic meteorology of the earth, particularly as influenced by the various activities of the sun; and not for the purpose of attacking purely statistical problems, requiring a long series of observations.

In the present incomplete state of this observatory, lacking as it does, the parts with which the magnetic observatory was designed to cooperate, viz: The departments of solar physics and atmospheric electricity, it is hoped that we may secure, by cooperation with the Naval Observatory and other places, the data required in certain investigations that we wish to take up in connection with the magnetic work.

Among the available problems, an exact quantative investigation into the relation between sun spots and magnetic storms seems very promising. Considerations in the light of the electron theory lead inevitably to the conclusion that the intimate relation that has long been known to exist between the variations of terrestrial magnetism, and various solar phenomena, especially sun spots, arises from the bombardment of the earth by electrons discharged from the sun. Discoveries of the utmost importance to meteorology, terrestrial magnetism, and atmospheric electricity are certain to ensue as the result of exact study in this field.

The comparative examination of meteorological and magnetic phenomena will, it is believed, bring to light interesting interrelations, particularly as it is now known that the atmosphere carries immense numbers of electrons that are not only active in producing variations in the magnetic field of the earth, but, as nuclei for condensation, enter intimately into a great variety of meteorological processes. Such effects, however, are difficult of detection for the reason that they are relatively small, and very accurate observations of both the meteorological and the magnetic elements will be required to separate them. It is also possible that a comparison of the variations of the solar constant with the magnetic variations will reveal a correspondence between the two phenomena that will thus provide a terrestrial index of the variatians in the energy emitted by the sun, and perhaps also of the long period variations in terrestrial climatic conditions.

These are the problems in mind and toward the ultimate solution of which, however far off, our work is being directed.

Destruction of the administration building.—About 4 o'clock in the morning of October 23, 1907, the interior of the administration building was discovered to be in flames. The fire spread so rapidly that the eight persons sleeping in the building that night barely escaped with their lives, two being seriously injured. It has been impossible to determine the origin of the fire. This building was used as an ordinary weather observing station, such as is maintained at all of the various meteorological reporting offices of the Bureau. It also contained the administrative offices and the kitchen, dining, sleeping, and general living rooms of the scientific staff. Since the fire, kitchen and dining rooms have been temporarily provided in the upper part of the stable, and sleeping rooms have been fitted up in what was once the farm cottage. It is hoped that an appropriation for the reconstruction of the administration building will be made available as soon as the appropriation bill for the support of the Department becomes a law. When the structure is rebuilt, it should be made entirely of fireproof material. At a later period tentative plans will be prepared so that an estimate can be secured of the cost of reconstructing the building.

FORECASTS AND WARNINGS.

During the last year the area from which daily meteorological observations are received by telegraph has been extended to include stations in European and Asiatic Russia, Iceland, the Faroe Islands, and Nome, Alaska. Isobaric charts of the Northern Hemisphere, based upon these reports and upon telegraphic observations received from selected points in western Europe, the Azores, Bermuda, the West Indies, Mexico, Hono-

lulu, and in the United States and Canada, have been prepared daily and employed with gratifying success in the preparation of practise or experimental forecasts for periods of five and six days in advance.

The tropical hurricanes of September and October, 1906, were the most important storms that have occurred in American waters in several years. The first of these storms appeared east of Barbados, W. I., August 31, moved thence northwestward to a point off the northern Bahamas, where it recurved to the northeastward during September 6 and 7, and past west and north of Bermuda during the 9th. The storm was exceptionally severe in the transatlantic steamer routes during the 10th and 11th, and apparently past north of Scotland on the 15th. From the first appearance of this hurricane until its final disappearance over the north Atlantic Ocean, its character and course were accurately defined in dispatches that were telegraphed daily to American and West Indian ports. The American consul at St. Thomas, W. I., wrote under date of September 4, 1906:

> * * * Your timely warning has saved millions to shipping in this harbor. * * *

The Weather Bureau observer at San Juan, Porto Rico, reported:

> * * * The storm apparently followed the course forecast in the message received September 1. All vessels were advised to remain in port; the advices were heeded, and no material damage has been reported. * * *

On the morning of the 8th when the storm had completed its recurve to the northeastward, Lloyds, London, was cabled that a tropical disturbance was approaching Bermuda from the southwest. On the following day the storm raged with great intensity in the region about Bermuda, and during the 10–11th showed exceptionally low barometric pressure, and was attended by gales of hurricane force over the mid-Atlantic Ocean.

A disturbance that had apparently developed in the wake of the hurricane above referred to, advanced northward from the West Indies over and east of the Bahamas from September 13 to 15, and then recurved westward to the Atlantic coast, north of Charleston, S. C., by the morning of the 17th. The subsequent course of this disturbance was northwestward over the interior, where it possest but slight energy. It recurved northeastward over the lower Ohio Valley during the 18th and 19th and reached Nova Scotia on the 21st.

The severest Gulf storm since the Galveston storm of September, 1900, advanced from the western Caribbean Sea northward to the Gulf coast, near and west of Mobile from September 23 to 27. The accurate and timely warnings in connection with this storm were, so far as known, heeded, and the great damage done by the storm to vessels in harbors of shelter indicates the almost inevitable fate of vessels whose masters may have ignored the warnings. Detailed description of these storms is given in the Monthly Weather Review for September, 1906.

During the second decade of October, 1906, a tropical storm of great intensity advanced from the western Caribbean Sea northeastward near and east of Havana and Key West. This storm caused great damage to the property of the Florida East Coast Railway along the extension from the Peninsula to Key West. House boats for workmen of this road were swept away and many lives lost. Warnings of this storm were timely and every effort was made to give them the widest possible distribution.

The particular new work of this division during the coming year will be the diligent study along practical lines of the problem of forecasting general and important weather changes and conditions for periods of a week or more in advance.

SEISMOLOGICAL OBSERVATIONS.

In my annual report for last year attention was called to the increasing importance of systematical seismological observations. Only a short time before that report was written an unparalleled seismic disaster laid San Francisco and other cities in central California in ruins. Exactly four months later a strikingly similar convulsion of nature devastated Valparasio and vicinity. Still later, namely, on January 14, the city of Kingston, Jamaica, was laid waste, and finally on the 14th of April a violent seismic disturbance was central in southwestern Mexico, where great damage and loss of life resulted.

The scientific world is now fully aroused to the importance of systematically observing and studying these natural phenomena of such vital consequence to the welfare of the people, for it is clearly recognized that with adequate data in hand the people can be advised how to best select and locate their habitations and how to construct them to best resist the disturbances to which they may be subjected.

Exact knowledge of the character and magnitude of the motion of the ground when subjected to earthquake action is of vital importance to architects and structural engineers whose business it is to design and erect the enormous structures now so numerous in all our great cities. Any one of these modern buildings often house a small army of people whose safety depends in a great degree upon the power of the structure to resist the forces that may assail it. Earthquake-proof construction must be required especially in great structures, even in regions which may seem to be immune, for probably it is only a question of time when some readjustment of the earth's strata under long accumulating stresses may occur in seemingly the most stable regions and an earthquake of greater or less severity be precipitated thereby.

The data required by engineers and architects to enable them to properly handle the problem presented to them is at present very meager, vague, and indefinite. In my last annual report I mentioned that an international bureau of seismology had been organized, with headquarters at Strasburg, the objects of which in general are to bring about the systematic observation and study of all seismic phenomena thruout the whole world. The United States Government is a member of this organization and is represented by Prof. H. F. Reid, of the Johns Hopkins University, Baltimore. At the present time, however, no organized establishment exists for the systematic observation and registration of earthquakes within the United States.

Earthquakes are great natural phenomena and the disasters at Charleston, in California, Chili, Jamaica, Mexico, and elsewhere demonstrated how much the interests of the whole people are affected by them. The scientific and systematic observation of earthquakes is now a recognized necessity. It is submitted that this important work, since it affects the welfare of all the people, devolves upon and should be undertaken by the National Government; and, furthermore, it is urged that the Weather Bureau be authorized to inaugurate and maintain systematic seismological observations within the United States and its Territories. In support of this recommendation, I desire to invite attention to the resolutions past by the seismological committee of the American Association for the Advancement of Science in a meeting held in Washington on April 19, 1907, as follows:

> (1) In the judgment of the committee, its functions should be regarded as initiatory and advisory.
> (2) In the judgment of the committee, the time has come for asking the support of the Federal Government in seismological work.
> (3) This seismological work requires a cooperation of the various scientific bureaus of the Government.
> (4) The appropriations for seismological stations should be made thru the United States Weather Bureau, and the results of the observations should appear in its publications.

(5) A committee of three, to include the chairman of the committee, should confer with the Chief of the Weather Bureau, the Superintendent of the Coast and Geodetic Survey, and the Director of the Geological Survey with reference to framing the legislation providing for seismological stations and the publication of observations, as recommended in the preceding resolution.

In the deliberations of the committee it was clearly recognized that the Weather Bureau already has numerous stations widely distributed over the country, and maintains a corps of highly-trained observers on duty at all times. By reason of this existing equipment the Weather Bureau is peculiarly prepared to include seismological observations in its work at the minimum cost of maintenance.

THE INVESTIGATION OF EVAPORATION IN CONNECTION WITH THE SALTON SEA.

While several studies have been made in the United States and Europe regarding the laws of evaporation over large bodies of water, the results have not been sufficiently in agreement to be satisfactory for the deduction of a proper system of laws designed for practical uses by engineers and meteorologists. The recent formation of a large lake of fresh water in the Salton Sea, southern California, caused by the overflowing of the Colorado River, affords an unequaled opportunity to take up the study of evaporation phenomena on a large scale under remarkably favorable conditions.

The Salton Sea is now 45 miles long, contains 440 square miles surface, which is 205 feet below the sea level, the bottom of the lake being 287 feet below the mean level of the Pacific Ocean, and it will evaporate at the rate of about 8 feet per year.

Mr. G. K. Gilbert, of the United States Geological Survey, proposed that this unique opportunity be embraced, especially in view of the facts that the Salton Sea lies in a dry climate, where evaporation is vigorous, where there is little rainfall, and only a small inflow of water from the New and the Alamo rivers, which can be readily measured, so that the evaporation conditions are comparatively free from complications. In order to study the possibilities of the case a board, consisting of Prof. F. H. Bigelow, United States Weather Bureau; Mr. G. K. Gilbert, United States Geological Survey, and Mr. C. E. Grunsky, United States Reclamation Service, proceeded to Yuma, Ariz., and in May, 1907, inspected the entire region carefully, making a favorable report on the undertaking. Some valuable preliminary experiments were made at Reno, Nev., during the summer, and next year it is proposed to install a chain of stations around the Salton Sea on a comparatively simple plan for the first year's work, and then proceed to a more elaborate campaign during the second and following years, as experience suggests shall be appropriate.

The rainfall and the evaporation are the two great factors which determine the amount of water available for irrigation purposes and for the supply of water that passes from the watersheds to the navigable rivers as floods or as normal stages, so that the engineers demand reliable data on this subject, which it is not at present possible to supply. While the Weather Bureau collects rainfall data in all parts of the country, there is nothing being done on the evaporation side of the problem, but it is hoped in the course of a few years to be able to add to our existing service the proper observations on evaporation, such as will enable us to publish a monthly map of evaporation to be used in connection with the rainfall map now being issued every month. In addition to the needs of the engineer, it is recognized that evaporation is an important factor in the economy of plant life, so that the agriculturalist should have access to suitable information regarding the amount of the loss of water in this way. This is especially true for the region west of the Mississippi River, where projects are under way that have such an important bearing on the future industrial development of that vast region, rich as it is in possibilities for the future. The introduction of the date palm industry in the immediate vicinity of the Salton Sea calls for special meteorological observations, because the maturing dates are very injuriously influenced by moisture in the air, such as may be produced by the evaporation of the sea or of irrigated fields.

The preliminary report of the board is as follows:

REPORT OF BOARD ON EVAPORATION STUDIES IN SALTON BASIN. LOS ANGELES, CAL., MAY 20, 1907.

In compliance with instructions received, the undersigned, F. H. Bigelow, representing the United States Weather Bureau; G. K. Gilbert, representing the United States Geological Survey, and C. E. Grunsky, representing the United States Reclamation Service, met at Yuma, Ariz., on May 12, 1907, for the purpose of outlining the scope and methods of an investigation of evaporation in connection with the drying out of Salton Sea, Cal. An organization as a conference board was effected by electing F. H. Bigelow chairman, and with all members participating the board was in session from day to day at various places in Salton Basin, and held a final session at Los Angeles.

It was recognized in advance that in order to determine the law which controls evaporation and thus utilize to the fullest extent the opportunity afforded by the drying out of the lake, the meteorological conditions at and near the lake must be thoroly investigated, and it was early apparent that financial considerations would make it impossible to install and put in operation at once the fully equipt stations required for this purpose. The board, therefore, has given special consideration, first, to the work which should be immediately undertaken with means now at command, and second, to the scope of the work as it should be carried out when suitable financial provision shall have been made.

The board confirms the conclusion reached by the earlier conference committee, that the Weather Bureau should direct the making of observations and should have primary charge of working up results.

Both the Geological Survey and the Reclamation Service should cooperate in the work to the extent found practical from time to time, and both of these bureaus should remain in close touch with the work. For this reason it appears a wise provision to have the scope of the work and the methods of observation past upon from time to time by this conference board, which should be continued indefinitely for this purpose.

It is foreseen that after the observations have been established on a comprehensive basis, they should be continued without interruption for two or three years. Whether for a longer period can not be determined until the results of two years' observations become available.

The board desires to express its appreciation of the preliminary work done in connection with this subject by the United States Geological Survey, which, upon a first suggestion that such a study should be made, at once ordered an examination by W. F. Martin, whose exploration of the shores of the sea and of the conditions of run-off from the surrounding country greatly simplified our own investigations. We found it necessary, however, to have personal knowledge of the physical condition of the country surrounding the large body of water, and also to know something of the condition which led to the formation of the lake, and to understand the present situation at Colorado River, which, if modified, may affect the accession to the waters of Salton Sea. Consequently, an inspection was made of the works which turned the Colorado River back into its proper channel, and of the levees extending some 10 miles beyond the lower Mexican heading which is intended to reduce the annual overbank flow toward the west and north.

The board visited the margin of the sea at its southern extremity and at several points on the east and northeast along the line of the Southern Pacific railroad, notably at Durmid, and at Salton. Inquiry and personal investigation were also made of the suitability of Yuma, Mammoth Tank, Brawley, Mecca, Indio, and Edom as stations for the meteorological observations required in connection with the direct observation of evaporation and with the study of the effect of a large body of water upon the rate of evaporation.

As a result of these examinations and upon consideration of all circumstances affecting the problem, the board recommends as follows:

First.—That the United States Geological Survey make gagings of all visible inflow of water into the lake.

Second.—That the United States Geological Survey furnish such facts as are ascertainable relating to probable loss of water into underground strata or relating to accession of water from underground sources.

Third.—That the United States Weather Bureau immediately—

(*a*) Raise the standard of its local office at Yuma.

(*b*) Establish stations at Durmid or Salton, at Brawley, and at Edom, and improve the service at Mammoth Tank, Mecca, and Indio, so as to secure from each of these stations the dry-bulb temperature, the wet-bulb temperature, the direction and force of the wind, the rainfall, the barometric pressure, and the evaporation from a Piche evaporometer.

(*c*) Establish evaporation pans at Yuma, at Mammoth Tank, at Brawley, at Mecca, at Durmid, if possible on land and afloat, and at Edom.

(*d*) Keep a record of water stage and water temperature at the railroad trestle near Durmid.

(e) Conduct experiments at any convenient point for the preliminary determination of additional factors influencing the rate of evaporation.

(f) Plan such self-registering apparatus as should be available for use in a thoroly equipt evaporation station.

Fourth.—That an appropriation be requested from Congress, for the Weather Bureau, to be used for continuing and expanding the observations at the points above mentioned; for the establishment of one or more thoroly equipt stations in the Salton Basin at which all phenomena affecting evaporation are to be studied; for the continuous determination by automatic gage of the lowering of the water surface of Salton Sea by evaporation; and for the compensation of all necessary assistants required in making, reducing, and discussing the observations.

The sum of money that should be set apart for this work at the next session of Congress is $25,000.

This estimate is based on a tentative plan of operation which remains subject to such modifications as the first year's experience may show to be necessary.

The estimate includes an item of $12,000 for installation and $13,000 for salaries, rents, and supplies. The item for salaries includes compensation at $1,500 per year for a physicist in the field, and compensation for two clerks at $1,200 each for the Washington office of the Weather Bureau; this item also includes $1,500 for laboratory experiments and the necessary incidental expenses.

FRANK H. BIGELOW,
Professor, United States Weather Bureau.
G. K. GILBERT,
Geologist, United States Geological Survey.
C. E. GRUNSKY,
Consulting Engineer in the United States Reclamation Service.

Importance of the proposed investigation. History of the Salton Sea.—Salton Basin, in the extreme southeastern part of California, is a depression below the level of the sea, its lowest point being 287 feet below mean tide. The basin is separated from the Gulf of California by the delta of the Colorado River. In past times the river has flowed alternately to the Gulf and to the basin. Four years ago all the water of the river flowed to the Gulf of California and the basin was dry. A canal made for irrigation purposes, leading water from the river toward the Salton Basin, became enlarged in time of flood and past beyond control, so after a few months the entire river discharged to the basin. For more than a year it flowed in that direction and it was finally brought under control only after strenuous effort. The river has now been returned to its former channel and discharges to the Gulf of California, excepting a small portion employed for irrigation in the Imperial Valley—"Imperial Valley" being the name given to that part of the river delta which slopes toward the Salton Basin.

While the river flowed into the Salton Basin it gradually flooded the lower part of the basin so that now there is a lake or sea about 80 feet deep with a surface area of 440 square miles. As important interests are involved, it may be assumed that the river will be restrained from again invading the basin and that the lake which now exists will gradually dry away, its dissipation requiring between ten and fifteen years.

Need for the investigation of evaporation.—In the construction of reservoirs, for whatever purpose, it is necessary to make allowance for evaporation in order to determine in advance what will be the available supply of water. In the work of the Reclamation Service the allowance for evaporation is often very large and affects the plans and estimates of cost in important ways. It is always a factor to be considered in estimating the available supply obtainable from a reservoir of known capacity and is likewise a factor used in determining the height of a dam of greatest storage efficiency. The exposure of an unnecessarily large area behind a dam of too great height may result in excessive wastage of the supply. Moreover an inadequate allowance for loss by evaporation from the reservoir surface leads to erroneous assumptions concerning the water which can be made available for useful purposes.

Unfortunately the rate of evaporation for different climates is not well known, so that at present it is impossible to make estimates with desirable precision. It is known that the rate of evaporation in any locality depends on certain factors, namely: The temperature of the air and water, the dryness of the air, and the velocity of the wind; but the nature of the law or formula connecting the evaporation with these factors is not known. Various attempts have been made to determine it, but the results are so discordant that little confidence is felt in any of them. It is known also that a formula for evaporation derived from experiments with a small water surface—such as that afforded by a tank, for example—can not be applied directly to the computation of the evaporation from a reservoir or lake, because the larger bodies are differently affected by the wind. As the air moves across a reservoir and gradually becomes charged with moisture its rate of absorption diminishes, and the average rate of evaporation from a broad surface is therefore less than from a small surface. For this reason the formula for evaporation can not be put on a sound basis without taking account of large water surfaces as well as small. Attempts to measure evaporation from lakes and reservoirs have heretofore been hampered by the difficulty of accurately measuring inflow and outflow so as to discriminate the various factors determining changes in the level of water surfaces.

Availability of the Salton Sea.—The conditions afforded by the Salton Sea are particularly suitable for the investigation of the laws of evaporation. The amount of water flowing into it is small and can readily be measured. The rainfall is nominal in amount. No water flows out of it. The climate is so dry that the total evaporation in the year will probably amount to 6 or 8 feet. It is, therefore, possible to determine by gaging the actual rate of evaporation, and to make this determination with high precision. By making the gaging continuous, and by making simultaneous observations of the temperature, atmospheric humidity, wind, etc., the relations of evaporation to these several factors can be made out. It is possible, also, by a suitable arrangement of details, and by the use of evaporation tanks, to take account of the relation of evaporation to the size of the evaporating surface.

By the reason of the dryness of the local climate the evaporation rate in the Salton Basin is unusually high. Therefore, a formula based on observations at this place will have such range as to be available for all cases likely to arise.

It is especially to be noted that the opportunity given by Salton Sea is both temporary and unique. In ten or fifteen years the sea will have disappeared, and in a somewhat shorter period its waters will have become so saline that its rate of evaporation will no longer be normal and representive. It is not to be restored if the resources of the engineer can prevent. Moreover, the combination of physical conditions and events by which the sea was created is so peculiar as to warrant the belief that it is not duplicated elsewhere. It is certainly not to be found in the United States. Unless use is made of the present crisis in the history of the basin the opportunity will be lost.

With reference to the practical value of the proposed investigation of evaporation, Mr. M. O. Leighton, Chief Hydrographer of the United States Geological Survey, writes as follows:

It is of utmost importance to all water supply installation to have the rate of evaporation under fixt and variable conditions determined. A few practical illustrations: It has been estimated that the evaporation in southern Arizona is equivalent to about 6 feet per year. Whether or not this is true we do not know. Assuming, however, that the figure is a fair approximation, the amount of water lost from the Roosevelt Reservoir, surface extent, 16,320 acres, will be 97,920 acre-feet, sufficient to irrigate 48,960 acres, assuming a duty of water equivalent to 24 inches per annum. The same computations may be made with respect to all the great reservoirs in the arid West. It will, therefore, be seen that in computing the area to be reclaimed under the Roosevelt Reservoir it was necessary to deduct nearly 50,000 acres from that which might have been reclaimed had it not been for evaporation. The Sweetwater and Otay reservoirs in the San Diego region in southern California have never

performed the duty that was expected of them. Indeed, during the greater part of the time since they were constructed they have been empty or only partially filled. The evaporation from these reservoirs is enormous, and it is highly probable that had there been any worthy information concerning the rate of evaporation at those points it would have been appreciated that the drainage areas would not provide for actual use an amount of water equivalent to the storage installation. In other words, the plans would have been entirely changed and a large amount of money would have been saved.

The above constitute two typical instances of the practical importance of determining all the factors connected with evaporation. If the facts were known, the engineering profession would probably change its ideas with reference to economic depth of water stored, and shallow areas within reservoirs at which it is assumed that evaporation may be greatest would be avoided. If the effects of winds were known, ideas with reference to the proper location of reservoirs would probably be changed, and there would be some useful study and experimentation with reference to the effect of wind-breaks, etc. In fact, we can only generalize about the matter, even as it is necessary to generalize with reference to the methods of evaporation study. Each reservoir in the west is subject to great loss. We do not know how much, but it is apparent that did we know subsequent work of this character would be more intelligently carried on.

FOREIGN METEOROLOGISTS STUDY AMERICAN WEATHER SERVICE.

It is probable that no other branch of science is as much indebted to the researches of citizens of the United States as is meteorology, Redfield and Espy, early in the nineteenth century, having been the first to collect the data, plat it, and exhibit to the world the cyclonic action of storms. Utilizing the knowledge thus made known and the further researches of the scientists of other nations, the United States has taken the lead in the practical application of meteorological science, our broad continental area and thoro electrical communication rendering it possible to bring an extensive system under one administrative head. The service is the result of an evolution, it being necessary to adopt new methods with each advancing step and to devise and invent appliances for putting into effect ideas that were unique. It has also required the application of discipline of military exactness in order to coordinate into an efficiently working machine 200 full meteorological offices, with more than 900 auxiliary stations, and to produce an efficiently working unit that shall twice daily gather meteorological data from such a large area, collate and print it at many commercial centers, and, thru the agency of the press, the telephone, and the rural free delivery, place the deductions from the data before those who can make the most use of them.

Within recent years many scientific representatives of foreign governments have honored us by visits and by a study of the methods employed by the United States in the administration of its Weather Bureau. They have also extensively used the technical library of the Bureau.

Reference is made below to some of those who have studied our methods.

In 1903 Mr. Gilbert T. Walker, the then newly elected director of the British-Indian Meteorological Service, came to this country to study our system of forecasting before assuming his new duties.

During the years 1890-1893 Rev. José Algué, Director of the Philippine Meteorological Service, spent several months examing the work of the Weather Bureau both at Washington and at some other stations before taking charge of the Manila Observatory. Similar studies were also made by himself and Father J. Clos, in 1900, preparatory to remodeling the work of the Philippine Weather Bureau in accordance with plans drawn up jointly by Father Algué and the Chief of the United States Weather Bureau.

During 1903-1906 several meteorologists of Japan, including especially Dr. S. Tetsu Tamura, took advantage of the facilities offered by our extensive meteorological library and by our professional staff to study the distinctive features of our service.

In 1906 Prof. Manuel E. Pastrana, director of the Central Meteorological Office of Mexico, devoted much time to the study of the methods of our administration.

During 1906-7 Father José Coronas, of Manila, spent some time studying the Weather Bureau forecast service. Unfortunately, his studies were interrupted for a considerable time by a serious illness.

In 1907 Dr. P. Polis, an eminent meteorologist connected with the German Government and forecast service, paid this country an official visit, and during a period of two months made an exhaustive study of our system, both at the Central Office in Washington and thruout the country.

RIVER AND FLOOD SERVICE.

The year was an active one for the River and Flood Service both as to details of administration, the occurrence of floods, and the work of forecasts and warnings in connection therewith.

A new river district center was established on May 1, 1907, at Phoenix, Ariz., with territory comprising the watershed of the Gila River. This territory was formerly a portion of the Denver, Colo., district, and was assigned to Phoenix for greater convenience of administration and increased efficiency in the matter of distribution of flood warnings. Several new stations were also located on the Colorado River and its confluents, the Green and Grand rivers.

The steady development of agricultural industries, largely the result of the reclamation work of the General Government, now under way in the valley of the Colorado River and its principal tributaries, carries with it a demand for detailed and reliable information as to the quantity of water to be expected during the growing season, as well as for warnings of the disastrous floods that have in late years occurred with considerable frequency. It is believed that the Weather Bureau can be of material assistance in this work with the facilities now in hand, altho opportunities will doubtless be afforded for much greater usefulness as means of rapid communication develop.

Twenty-three special river and twelve special rainfall stations were established during the year, principally in the watersheds of the Colorado, Sacramento, and San Joaquin rivers.

Four special river and seven special rainfall stations were discontinued without impairment of the efficiency of the service.

The district of Sacramento, Cal., is now in excellent condition and performed efficient service during the flood of March, 1907, the greatest flood in the history of the State. A considerable number of new stations was established in this district, and it is thought that with the addition of a few more this service will be thoroly equipped for any future contingencies.

Other changes thruout the country were of a minor character.

By reason of the great amount of commerce carried upon them and the enormous property values affected by overflows, the Ohio River and the Mississippi River below Cairo, Ill., easily make the largest demands upon the labor, time, and money of the River and Flood service. The present service is adequate so far as the work of actual forecasting is concerned; there is, however, a constant demand for increased service from many important cities and towns that are not special river stations. These places not only wish flood warnings, which they now receive, but also daily information as to the stage of the water at the different places, claiming that such information would be of the greatest assistance to the navigation interests. The claim is well founded and it is intended that such provision be made as will admit of the publication of a daily river bulletin at the more important river cities and towns where such service is not now provided, the

data to be telegraphed or telephoned each morning from the nearest Weather Bureau center. The value of such service is practically beyond question, and its establishment would simply fulfil the legitimate desire of the people interested.

It may be necessary in a year or two to make some provision for river service in the watershed of the Yukon River for the benefit of the navigation interests. The subject has been informally brought to the attention of the Weather Bureau with some tentative suggestions, but it is not proposed that anything shall be done during the next fiscal year.

It is also becoming apparent that some additional service will probably be necessary in the future along the large tributaries of the Arkansas River, such as the Cimmaron, and both forks of the Canadian, and possibly along the Red River above Denison, Tex. Such a service should prove of much value to the increasing agricultural interests of Oklahoma and Indian Territories, and the question will be made a subject for further consideration.

The great floods of the year were three in number, all occurring between January and March.

The first was that of January and February in the Ohio and lower Mississippi rivers, when stages in the former river were the highest of record, with the exception of those of 1883 and 1884, the records covering a period of nearly one hundred years.

The warnings issued by the Weather Bureau in connection with this flood were accurate both as to time and stage, and were the direct means of saving an immense amount of property. The Cincinnati Price Current in an article on the flood stated that—

> The Weather Bureau office at Cincinnati has rendered very important service incident to the flood conditions, in furnishing current information and in pointing out what might be expected. The gradual rise, with the warnings, made it possible to do a great deal preparatory to conditions of inundation.

There were numerous testimonials of a similar character from Pittsburg to New Orleans, and under date of February 9, 1907, the New Orleans Times-Democrat said:

> The river reached 19 feet here yesterday, as forecast by the United States Weather Bureau eleven days ago. The forecasts have been exceptionally accurate, both as to the expected stages and the time of their occurrence.

The second great flood occurred in the Valley of California, beginning early in February. This flood was the greatest in the recorded history of the State of California; it flooded 300,000 acres of reclaimed land and caused a loss of or damage to property amounting roughly to $5,000,000. The warnings issued were accurate; the service was satisfactory to a high degree, and brought forth many expressions of commendation and appreciation.

The third flood occurred during March in the Ohio River, particularly along the upper portions, and at Pittsburg the water reached the highest stage of record. The usual warnings were issued promptly, but skepticism on the part of some persons unacquainted with the true facts resulted in considerable damage that might otherwise have been avoided.

Another flood deserving of mention was that caused in January by the great ice gorge in the Grand River of Michigan. The service performed during this flood was of the highest character, and to the official in charge of the river district of Michigan were tendered the thanks of both the citizens of Grand Rapids assembled in mass meeting and of the common council of the city.

CLIMATOLOGICAL SERVICE.

The Climatological Division is charged with (1) the collection and publication of climatological data, and (2) the distribution of forecasts and special warnings. Under the first-named heading may be classed:

(*a*) Cooperative stations, of which there are more than 3,600.

(*b*) Cotton, corn and wheat, and sugar and rice region stations, and the publication at district centers and selected Weather Bureau stations for the period from April to October of daily bulletins showing the temperature and the precipitation for the growing fields.

(*c*) The monthly and weekly publications of the several sections of the Climatological Service, including the monthly snowfall bulletins of the States of the Rocky Mountain and Plateau regions for the period from December to March.

(*d*) The preparation of the National Weekly and Monthly Weather Bulletins, and the weekly Snow and Ice Bulletin issued during the winter months.

Cooperative stations.—As for several years past, the object has been to increase the accuracy of the observations at the cooperative stations, rather than to increase the number of stations, which is somewhat smaller than at the close of the previous year, 250 having been established and 270 discontinued for various reasons. Practically all of these stations are now equipped with standard instruments, which are exposed in an approved manner. One hundred and seventy-seven (177) stations were visited by section directors for the purpose of inspection.

Cotton, corn and wheat, and sugar and rice region station.—The number of cotton region stations (144) is the same as at the close of last year, 3 having been established and 3 discontinued. They are grouped under the same district centers as last year, 13 in number, namely: Atlanta, Augusta, Charleston, Galveston, Little Rock, Memphis, Mobile, Montgomery, New Orleans, Oklahoma, Savannah, Vicksburg, and Wilmington. Other Weather Bureau stations issuing daily bulletins, containing for the most part the averages of temperature and rainfall of the various districts only, are: Birmingham, Charlotte, Chattanooga, Cincinnati, Fort Worth, Macon, Meridian, Norfolk, Raleigh, St. Louis, San Antonio, Shreveport, and Taylor. The average edition of the daily bulletin is 33, the greatest issue being that from Memphis, 77. The data supplied by these stations continue to be of great value to those interested in the production of cotton and other crops. The rigid rules with regard to the time of making the bulletins public, namely, 11 a. m., seventy-fifth meridian time, have been strictly adhered to. Nine stations in the sugar and rice region of Louisiana report to the New Orleans cotton region district center and their observations are published in the cotton region bulletins issued for that center.

The number of corn and wheat region stations (134) is also the same as the close of last year, 1 having been established and 1 discontinued. These stations are identical in character with the cotton region stations and cover the great cereal producing belt. They are grouped under 9 centers, as follows: Chicago. Columbus, Des Moines, Indianapolis, Kansas City, Louisville, Minneapolis, Omaha, and St. Louis. Duluth, Peoria, and Topeka issue bulletins containing the district averages only. The average edition of the daily bulletins is 66 copies, the maximum number, 134, being issued from Kansas City.

Climatological publications.—The monthly reports and annual summaries of the 44 sections of the Climatological Service have been published without change in form. The monthly reports in all but two instances consist of eight page publications, containing charts of mean temperature and total precipitation, tables of miscellaneous climatological data, daily temperature extremes, and daily precipitation, together with two pages of descriptive text. Owing to rigid economy and a careful system by which the mailing lists are purged of the addresses of those not specially interested in these publications, the total edition is somewhat less than at the close of last year. These reports continue to supply to varied and important interests reliable climatological information for nearly every part of the United States. They have been published

with the usual promptness, the majority making their appearance before the 20th of the month succeeding that to which they pertain, and the remainder, with the exception of that of Hawaii and a few issued at the expense of their respective States, are usually printed within 30 days after the close of the month to which they pertain. The section publications are closely scrutinized by the Climatological Division of the Central Office, with a view to maintaining a creditable literary standard as well as to insure accuracy in the publication of the meteorological statistics and sound conclusions in the discussions presented.

The weekly weather bulletins of the several sections have been regularly published. The elimination of the crop feature has caused a decrease in the number issued, as indicated by the reduction in the combined edition, which is about 4,000 less than it was at the close of the preceding year.

The National Weather Bulletin issued from the Central Office continues to supply valuable information. It presents geographically the distribution of temperature and precipitation, a discussion of these elements, and a brief summary of the weather conditions prevailing during the week, or month, in each State. The edition of this publication on June 30, 1905, was 4,600; on June 30, 1906, it was 2,560; and on June 30, 1907, only 2,200. It is likely, however, that there will be no further decrease, which was occasioned by the elimination of the crop feature from the report.

The following table shows for each section the number of cooperative observers, the number of weather correspondents, and the editions of the weekly weather bulletins and monthly climatological reports:

Cooperative observers, weather correspondents, and editions of climatological publications.

Section.	Number of—		Publications issued.	
	Cooperative observers.	Weather correspondents.	Weekly bulletins.	Monthly climatological reports.
Alaska	40	....	....	....
Alabama	37	95	500	500
Arizona	77	110	600	600
Arkansas	68	61	520	650
California	350	50	500	700
Colorado	93	34	300	700
Florida	58	60	725	400
Georgia	42	150	1,000	920
Hawaii	143	53	318	376
Idaho	56	76	600	450
Illinois	90	90	820	450
Indiana	59	149	620	725
Iowa	123	400	2,600	2,600
Kansas	91	85	1,500	1,250
Kentucky	44	44	415	515
Louisiana	42	71	500	700
Maryland and Delaware	49	65	400	375
Michigan	115	124	548	950
Minnesota	70	60	600	400
Mississippi	64	85	700	550
Missouri	82	111	500	457
Montana	83	120	600	600
Nebraska	150	404	740	585
Nevada	44	46	150	300
New England	132	50	350	700
New Jersey	42	55	500	325
New Mexico	87	70	1,100	1,000
New York	125	122	875	825
North Carolina	61	118	800	1,050
North Dakota	85	36	500	500
Ohio	98	115	850	550
Oklahoma and Indian Territories	66	190	700	650
Oregon	83	32	500	750
Pennsylvania	87	65	330	600
Porto Rico	41	25	135	375
South Carolina	32	50	480	476
South Dakota	60	106	670	650
Tennessee	48	90	425	475
Texas	147	145	800	1,600
Utah	82	153	500	600
Virginia	55	95	325	925
Washington	89	80	800	900
West Virginia	55	65	900	590
Wisconsin	67	67	600	655
Wyoming	72	27	375	350
Yellowstone National Park	10	....	....	....
Total	3,684	4,269	27,986	30,299

The weekly Cotton Region Weather Bulletin was issued regularly from the New Orleans office, as heretofore. This publication contains two charts showing, respectively, the departures from the normal temperature and the total precipitation for the States comprising the cotton belt, a brief summary of the general weather conditions, and duplicates of the telegraphic weather summaries for cotton States as published in the National Weather Bulletin.

The Snow and Ice Bulletin shows the depth of snow on the ground and the thickness of ice at 8 p. m., seventy-fifth meridian time, on Mondays during the winter, as indicated by the reports from regular Weather Bureau stations and selected cooperative stations. The edition at the close of the season in March, 1907, was 1,400.

Distribution of forecasts and special warnings.—While this work has been conducted on lines identical with those of previous years, the main efforts have been largely confined to extending the distribution thru the medium of the local and long-distance telephone companies.

During the past autumn and winter the telephone companies operating lines in the South Atlantic and Gulf States were invited to cooperate with the Weather Bureau and give the daily forecasts to their subscribers, particularly in rural and agricultural districts. As a result of this correspondence, 135 telephone companies made the forecasts available for the benefit of over 72,500 subscribers in the trucking sections of the districts referred to during the season when they were most valuable. Similar action was also taken during the spring of 1907 covering the States of the central valleys.

At the close of the fiscal year there are of record the names of 1,633 telephone companies cooperating with the Weather Bureau in the distribution of forecasts, representing in round numbers nearly 2,000,000 subscribers who may obtain the forecasts daily by calling "Central", an increase of 971,620 over the number given in the last annual report.

Quite a number of the smaller companies have a distinctive signal by which they call up all rural subscribers on each circuit and give them the weather forecast each day as soon as it is received from the district center.

As opportunity presents it is proposed to bring this form of forecast distribution to the attention of the officials of every telephone company in the country and invite their cooperation, as experience has demonstrated the fact that this mode of dissemination is by far the most economical yet adopted for placing the forecasts before the public at the earliest possible moment after they are ready for issue.

An increase of 130 is shown in the number of stations receiving daily forecasts by telegraph at Government expense, as a result of the additional number of centers required in the great increase in telephonic distribution, altho the rural telephone has permitted the discontinuance of a large number of centers of the Rural Free Delivery Service, which formerly received telegraphic forecasts at the expense of this Bureau.

The number of post-offices, or addresses, receiving daily forecasts by mail is now 78,109, which is 1,390 more than the number supplied by this means at the close of the previous year, while the number of patrons receiving forecasts thru the Rural Free Delivery has been reduced 11,166, owing to the substitution of the rural telephone for this service.

The distribution by railway telegraph lines remains practically the same, and there are 1,091 less places receiving forecasts thru the cooperation of railway train baggagemen.

There is now of record a grand total of 2,141,151 addresses to which the daily forecasts are sent, or points where they are available for public benefit.

Climatology.—An important contribution to the needs of the people was made in the issue of Weather Bureau Bulletin Q, Climatology of the United States, by Prof. Alfred J. Henry. The bulletin makes a quarto volume of 1,012 pages; it contains

a comprehensive summary of the most important climatic elements, and rather complete climatic statistics for each State and Territory, excluding only Alaska and foreign possessions. The report is in great demand. It reflects credit upon its author.

The following table shows in detail the distribution of forecasts and special warnings in the various States and Territories:

Distribution of daily forecasts and special and emergency warnings.

State or Territory.	At Government expense.			Without expense to United States by—				
	Forecasts and special warnings.	Special warnings only.	Emergency warnings.	Mail.	Rural free delivery.	Telephone.	Railroad train service.	Railroad telegraph.
Alabama	32	8	139	1,191	1,065	1,257	4	111
Arizona	8	0	0	142	0	582	0	0
Arkansas	27	5	102	589	302	1,608	0	5
California	31	11	0	1,245	4,561	19,496	0	2
Colorado	17	62	39	1,012	938	6,890	0	1
Connecticut	14	0	49	1,379	50	58,250	142	0
Delaware	12	0	0	98	1,188	1,865	0	25
District of Columbia	0	0	0	1,365	0	10,000	0	0
Florida	32	134	32	1,005	43	5,057	0	57
Georgia	40	84	241	1,762	1,135	5,047	72	262
Idaho	9	0	0	320	55	7,522	0	0
Illinois	152	1	468	3,375	4,324	467,554	426	30
Indiana	95	1	208	2,160	2,193	84,446	132	64
Indian Territory	7	0	4	252	100	4	0	69
Iowa	160	5	490	2,061	6,687	94,908	25	0
Kansas	110	2	186	1,269	5,680	12,845	0	22
Kentucky	39	36	96	1,691	699	66,561	0	16
Louisiana	37	36	61	666	207	4,075	0	12
Maine	16	1	40	1,038	877	811	0	0
Maryland	28	4	42	2,100	1,196	5,301	0	88
Massachusetts	21	11	65	3,092	810	14,933	80	0
Michigan	90	5	379	6,669	900	107,558	160	242
Minnesota	104	6	196	8,226	6,510	97,969	0	13
Mississippi	40	7	118	867	713	4,567	0	6
Missouri	76	3	240	3,976	2,660	105,942	0	25
Montana	12	25	18	446	50	9,087	0	0
Nebraska	110	5	221	1,129	958	39,199	0	0
Nevada	4	0	0	70	0	0	0	0
New Hampshire	20	0	34	849	1,564	1,481	16	0
New Jersey	31	18	45	1,187	0	11,160	0	108
New Mexico	7	1	0	73	0	301	0	20
New York	121	46	865	7,853	3,278	116,625	205	199
North Carolina	73	14	180	969	3,695	9,639	0	5
North Dakota	15	2	99	189	1,305	99	0	0
Ohio	94	97	312	6,421	1,434	358,476	23	13
Oklahoma	30	1	13	401	1,194	8,117	0	56
Oregon	14	0	0	581	535	6,208	0	0
Pennsylvania	90	9	367	4,138	534	67,993	1	552
Rhode Island	2	0	12	443	0	404	13	0
South Carolina	31	8	100	914	600	1,070	0	40
South Dakota	52	22	77	720	861	15,750	0	0
Tennessee	40	5	291	1,252	1,775	14,059	2	2
Texas	96	54	240	1,199	3,770	33,337	0	33
Utah	9	36	0	382	826	29,000	0	0
Vermont	18	0	46	867	366	467	12	8
Virginia	64	4	96	1,826	1,533	18,824	101	41
Washington	27	0	0	728	1,517	23,695	0	0
West Virginia	26	7	55	1,130	83	16,415	0	7
Wisconsin	106	11	298	2,275	2,990	20,929	9	0
Wyoming	6	3	8	117	40	3,502	0	0
Total	2,280	734	5,998	78,109	71,300	1,965,905	1,428	2,134

OCEAN METEOROLOGY.

The function of the Bureau in respect to ocean meteorology is (1) the issuance of daily storm warnings and weather forecasts for the benefit and protection of shipping; (2) the collection of meteorological and physical information pertaining to the various oceans, their atmospheric disturbances, winds, currents, temperatures, densities, ice conditions, etc.,; (3) the reduction of this information to such shape and its publication in such form as will prove of highest value to commerce and navigation.

The information in question is obtained entirely thru a system of voluntary cooperation with the Bureau on the part of the vessels of the naval and merchant marine of every maritime nationality on the globe, a specifically designated observer aboard each cooperating vessel being under instructions from master or owner to furnish the Bureau with certain daily observations, to wit, a statement of the meteorogical conditions existing at the hour of Greenwich mean noon of each day that the vessel is at sea; the Bureau in return promising to furnish master and observer with a copy of such publications as may be founded upon the observations in question.

Blank forms (Form No. 1201—O. M.) for recording the observations and franked return envelops for inclosing these forms are provided by the Bureau. By the courtesy of the Department of State, moreover, forms left at any American Consulate are forwarded with the official consular mail. Thus, in no case is the observer put to the expense of postage. No instruments are provided, the intention being that the observer shall in each case employ those belonging to the vessel to which he is attached, the policy of the Bureau in this respect being to encourage owners, for the sake of their own interests, to provide a suitable instrumental outfit.

Number of cooperating marine observers.—The total number of vessels that have furnished meteorological reports (Form No. 1201—O. M.) during the past year is, 1,216, distributed as follows:

British	633
American	193
German	148
French	53
Dutch	41
Danish	31
Italian	30
Japanese	7
Spanish	15
Austrian	12
Norwegian	11
Belgian	9
Russian	6
Portuguese	7
Chinese	4
Cuban	2
Chilian	2
Argentina	1
Haytian	1
Total	1,216

The total number of meteorological reports (Form No. 1201—O. M.) returned by these cooperating observers during the year was 8,588, distributed over the various oceans as follows:

North Atlantic	7,061
South Atlantic	221
North Pacific	984
South Pacific	211
Indian	111
Total	8,588

As an illustration to owners and observers of the instruments required by the service, each of these offices has been furnished a wet and bry-bulb thermometer, with protecting louvre, suitable for use aboard ship. Four of them, viz, New York, Philadelphia, Baltimore, and Norfolk have received marine barometers of the type recommended by the Bureau, provided with a special suspension and protecting case, the device of Prof. C. F. Marvin, by means of which the barometer is safely housed except when in actual use. Fourteen (14) similar barometers remain in the hands of the manufacturers awaiting transportation (necessarily by hand) to the local offices for which they are destined. It is also the intention to furnish each of the local offices engaged in this work with the apparatus devised by Mr. James Page, for determining the local direction and force of the wind from the deck of a rapidly moving vessel, a matter which has hitherto been a cause of considerable inaccuracy in meteorological observations at sea.

As evidence of its appreciation of the voluntary and arduous services rendered by these cooperating marine observers, and as an inducement to further efforts on their part, the Bureau has during the past year awarded to such of them as have

returned reports of distinctive excellence one or more gnomonic charts of the various oceans, a limited edition of which was obtained from the Bureau of Equipment, Navy Department. These charts, the object of which is to facilitate the practise of great circle sailing, have proved a most valuable adjunct to the work.

Local offices assisting in the ocean meteorological work.—The list of local offices equipped to assist in ocean meteorological work of the Bureau, with the number of completed reports (Form No. 1201—O. M.) received and blank reports distributed by each during the year is as follows:

Station.	Form No. 1201—O. M.	
	Expended.	Received.
Portland, Me	75	44
Boston, Mass	294	239
New York, N. Y	2,530	2,226
Philadelphia, Pa	651	411
Baltimore, Md	363	296
Washington, D. C	6,808	4,380
Norfolk, Va	105	86
Wilmington, N. C	16	4
Charleston, S. C	16	6
Savannah, Ga	53	24
Jacksonville, Fla	64	5
Key West, Fla	18	1
Tampa, Fla	21	12
Pensacola, Fla	469	26
Mobile, Ala	24	4
New Orleans, La	282	168
Galveston, Tex	195	137
Tacoma, Wash	162	36
Seattle, Wash	140	93
Portland, Oreg	377	52
San Francisco, Cal	682	293
San Diego, Cal	65	26
Honolulu, H. I	50	19
Total	13,459	8,588

Utilization of the observations.—The meteorological observations thus received from the cooperating marine observers are utilized for two distinct purposes.

1. The construction of daily synoptic weather charts, showing the meteorological conditions prevailing over the ocean, at Greenwich mean noon of each successive day.

Apart from their value to the student of meteorology it is only by a study of these charts that the practical navigator can learn to properly appreciate the value of his own isolated observations as an aid to forecasting the changes of weather about to ensue, and of shaping such course as to profit by them; it is only from such charts that he can obtain a knowledge of the character and progress of ocean storms, of the regions of the ocean in which they are liable to occur, of the method of handling his vessel so as to avoid dangerous proximity to the center, and of even exchanging the foul and violent winds by which his vessel is beset in one semicircle of the rotating system for the fair and moderate winds of the others.

The construction of these charts is at present confined to the limits of the north Atlantic and north Pacific oceans, the number of observations received for the waters of the Southern Hemisphere having proved thus far insufficient to justify a like attempt for the south Atlantic, the south Pacific, and the Indian oceans. The efforts of the Bureau are at present directed to the task of increasing the number of cooperating observers in these waters, and with strong hopes of success.

2. Tabulation with a view to obtaining an accurate knowledge of the monthly climatology of the sea.

Aside from its scientific value, the purpose of this tabulation is to furnish navigators with a statement of the average conditions of wind, weather, currents, fog, ice, etc., prevailing over the ocean for each month in the year, enabling them to so shape their course that they may derive full advantage from favorable and suffer least disadvantage from unfavorable conditions.

This tabulation has been carried forward with vigor during the year, and in the case of the south Atlantic Ocean is now practically completed for the months of January, February, March, April, May, and June, the period covered extending from 1888 to 1906. Under date of April 15, 1907, the Chief of the Bureau of Equipment, Navy Department, requested the aid of the Weather Bureau in revising the information published upon the monthly Pilot Charts of the north Pacific Ocean, issued by the United States Hydrographic Office. In compliance with this request the tabulation of the observations for the north Pacific Ocean was undertaken, and the result will be furnished the Bureau of Equipment for publication upon the monthly Pilot Charts for the year 1908.

In addition to the above the Bureau has, at monthly intervals during the year, furnished the Bureau of Equipment, Navy Department, with the following information for publication upon the Pilot Charts:

1. A statement of the region and average monthly frequency of fog over the north Atlantic Ocean during the 9-year period, 1898–1906.

2. A statement of the region and monthly average frequency of gales over the north Atlantic Ocean during the 10-year period, 1897–1906.

3. A chart showing the positions of the center, upon successive days, of all important cyclonic storms that have occurred during each month of the 5-year period, 1902–1906, within the limits of the north Atlantic Ocean.

WIRELESS TELEGRAPHIC WEATHER SERVICE.

The essential feature of this service is the collection by wireless telegraphy of meteorological observations from vessels at sea, and the dispatch by the same means to vessels at sea of weather forecasts and storm warnings based upon the observations thus collected.

The following vessels, all equipped with the Marconi apparatus, have been authorized to transmit to the Bureau the record of the daily Greenwich mean noon meteorological observations, and have been supplied with the telegraphic code, forms, etc., required for that purpose:

American Line: S. S. *New York, Philadelphia, St. Paul, St. Louis.*

North German Lloyd: S. S. *Grosser Kurfurst, Kaiser Wilhelm II, Kaiser Wilhelm der Grosse, Kronprinz Wilhelm.*

Hamburg American Line: S. S. *Amerika, Bluecher, Deutschland, Kaiserin Augusta Victoria.*

Cunard Line: S. S. *Campania, Carmania, Caronia, Carpathia, Etruria, Ivernia, Pannonia, Saxonia, Slavonia, Ultonia, Umbria.*

White Star Line: S. S. *Arabic, Baltic, Cedric, Celtic, Cymric, Majestic, Oceanic, Teutonic.*

Compagnie Generale Transatlantique: S. S. *La Bretagne, La Lorraine, La Provence, La Savoie, La Touraine.*

Allan Line: S. S. *Corsican, Victorian, Virginian.*

Canadian Pacific Steamship Line: S. S. *Empress of Britain, Empress of Ireland.*

The privilege has also been extended to the following vessels equipped with the De Forrest system:

Panama Railroad and Steamship Company: S. S. *Advance, Alliance, Colon, Finance, Panama.*

Mallory Line: S. S. *Concho, Denver, San Jacinto.*

Also to the following equipped with the Massie system:

Pacific Steamship Company: S. S. *President.*

The *President* is as far as known the only vessel on the Pacific carrying wireless apparatus. Other vessels are said to be in course of equipment, and the wireless weather service on that coast in view of its supreme importance in the matter of local forecasting will be prosecuted with vigor.

The wireless telegraphic weather service and code have also been adopted by the United States Navy Department, and all vessels of the United States Navy are instructed to transmit the daily weather dispatch while at sea. The wireless tele-

graphic stations controlled by the Navy Department are also required to receive weather messages from merchant vessels and to transmit them to the Bureau; likewise to dispatch the weather forecasts and storm warnings issued by the Bureau to vessels at sea demanding them, free of cost.

The total number of wireless weather reports received during the year from vessels at sea was 738. Of this number 679 from transatlantic liners distributed along the route between Sandy Hook and longitude 44° west.

INSTRUMENTS.

Station equipments.—For a number of years past it has been the policy of the Bureau to equip all the regular telegraphic stations with complete sets of automatic instruments for recording the temperature and pressure of the air, rainfall, sunshine, and the velocity and direction of the wind. This work has been carried forward gradually as funds were available, and all the important stations are now fully supplied. The same uniform type and character of equipment is also issued to all new stations. The installation of automatic river-stage indicators referred to in my last annual report has been extended to the stations at St. Louis, Mo., and Pittsburg, Pa.

During the last year the Bureau made an extensive display of instrumental apparatus, charts, photographs, etc., exhibiting its work at the Western Pennsylvania Exposition held at Pittsburg. This entire exhibit, with additional features, was reinstalled at Jamestown. All this work has been under the immediate supervision of Prof. C. F. Marvin, Chief of the Instrument Division.

Extensive improvements are now nearly completed in the instrumental equipment of the Washington station, and arrangements have been effected for the consolidation in one observatory room of the instruments employed in making regular observations and those heretofore maintained especially for exhibit and instructional purposes.

New apparatus and improvements.—Careful attention has always been given by the Instrument Division to the development of new forms of apparatus, the improvement of old instruments, and their better adaptation to the special requirements of the work of the Bureau. During the past year much important work of this character has been accomplished, of which the following items deserve special mention:

(1) The construction of an improved recording wind vane, such as employed at all regular stations. In this ball bearings are substituted for the antifriction wheel bearings previously employed, and a simplified construction of the electrical contact-making mechanism is provided. The idea has been to reduce the size of the apparatus and make it wholly self-contained, so that worn and damaged parts may be more readily replaced and the entire vane and recording attachments can be easily set up or removed as a unit. Heretofore the vane has been a relatively large affair and the recording mechanisms separately connected, so that repairs and renewal of parts are not so easily effected.

(2) The completion and testing of a mechanically-recording mercurial barograph of great precision. In this instrument the record is magnified five times and very slight oscillations of pressure are accurately recorded and measurable on the diagram. The instrument is fully compensated for temperature.

(3) Considerable attention has been given to the subject of measuring and recording evaporation from free water surface, and an experimental tank has been provided with an electrical float device which operates to maintain the water in the tank constantly at exactly the same level. If the water evaporates and lowers the level, a sufficient quantity of water to restore the level is admitted thru a tipping bucket, by which the quantity of water admitted may be measured and recorded. So likewise during rainfall the excess of water is drawn from the tank and measured and recorded by means of another tipping bucket. When these experiments were well advanced the Bureau took up the great project of evaporation studies at the Salton Sea, as described elsewhere in this report. The results of Professor Marvin's work, including certain micrometers, hair hygrometers, psychrometers, anemometers, and apparatus devised for that work, have been turned over to Prof. Frank H. Bigelow, in charge of the Salton Sea evaporation project.

About 20 sets of the instruments needed for making meteorological observations aboard ships at sea were prepared for installation at Weather Bureau offices in maritime exchanges and elsewhere. The Bureau does not supply any instruments for its ocean meteorological work, and the objects in view in exhibiting these sets of instruments at maritime centers is to show interested persons the most suitable instruments for the purpose, and how they may be best installed and used. The instruments comprise a high grade mercurial barometer of the marine type, swung in gimbals, and a set of wet and dry-bulb mercurial thermometers, mounted within a small louvered shelter of appropriate construction. The barometer is mounted within a mahogany case by means of a special support of such construction that the barometer can be swung free, and the pressure observed independent of the motion of the ship. The instrument thereafter can be readily replaced and secured within the case, where it is completely preserved from accidental injury. A single model of a device invented by Mr. James Page, formerly in charge of the Division of Ocean Meteorology, for deducing the true force and direction of the wind aboard moving vessels at sea, was also made in the shops of the Instrument Division. The rapid motion of fast going ocean vessels sets up such a strong *apparent wind* that the true force and direction of the wind are difficult to observe, and are often incorrectly reported. The device in question enables the desired result to be deduced from the *apparent wind* and the known motion of the vessel.

(5) Important improvements have been made in the weighing mechanisms of the recording rain and snow gage, of which a limited number have been in use at important stations of the Bureau. The automatic balance has been simplified and entirely reconstructed, and its capacity increased. The weighing parts of the mechanism can now be completely dismantled, for cleaning, and be replaced in a few minutes.

(6) Elaborate detail working drawings have recently been completed, under the direction of Professor Marvin, for an automatic kite reel of great power and capacity. In scientific kite flying to great elevations, an elaborate automatic reeling mechanism, for managing the steel piano wire with which the kites are held, is indispensable. In the design now referred to, a capacity of over 50,000 feet of wire, 0.04 inch in diameter, is provided in the storage drum, with an estimated resistance to crushing of nearly one million pounds. This great strength is necessary to withstand the cumulative crushing strain due to winding many thousands of feet of wire under tension. The reel is driven by a variable speed electric motor, and the wire is automatically guided and distributed systematically over the face of the drum. The length of the wire unwound, and the amount on the drum, are shown by means of suitable indicators, and a specially devised dynamometer indicates the tension upon the line at all times, whether the wheel is in motion or at rest.

(7) The exact measurement of the moisture contents of the atmosphere is one of the most difficult meteorological observations that have to be made, especially at low temperatures and in contracted quarters, and where great exactness is necessary, as in many special studies. Experiments are now in progress with a new apparatus for this purpose, which promises to yield very accurate and useful results. The apparatus shows directly the pressure of the aqueous vapor, the readings being given in thousandths of an inch.

LIBRARY.

Thru exchange for Weather Bureau publications or by gift there have been received 105 periodicals, 705 books and pamphlets, daily weather maps from 17 foreign meteorological services, and weekly and monthly summaries from 59 foreign meteorological services or observatories. Numerous duplicates and publications not relating to meteorology and not retained in our library are not included in the above enumeration; such publications have either been returned to their authors or donated to other libraries.

The total number of permanent accessions during the year, including bound files of periodicals, was 1,028. The total number of accessioned titles in the library has now reached 27,173.

The marked increase in the number of publications received thru exchange is largely due to the systematic effort that has been made to collect the most detailed climatological data from all parts of the world; especially from those regions whose climate is but little known. The extension of the work of the library along these lines has been in response to an increasing demand for such data. Especially urgent have been the requests from the Bureau of Plant Industry, in connection with its work of plant introduction. Thousands of plants are now received annually by that Bureau from its trained explorers in foreign countries, and it is of the highest importance to know, for each plant, the climate of its natural habitat, in order to determine the section of our own country in which it is most likely to succeed. The work of collecting and collating such data has been carried on by the assistant librarian, Mr. C. F. Talman, who has contributed numerous paper along this line to the Monthly Weather Review, including much information obtained by personal correspondence and not, therefore, available in printed form.

Frequent requests have also been made by investigators during the past year for temperature and rainfall records extending over a long period of years. These requests have, in general, been satisfactorily met. Bibliographers have also consulted this library for works on meteorology not to be found elsewhere in this country.

The general bibliographic work, including the publication in the Monthly Weather Review of lists of "Recent additions to the Weather Bureau Library", and "Recent papers bearing on meteorology", has been continued as heretofore, with the addition of weekly lists in manuscript for use of the officials at the Central Office.

During the winter the assistant librarian made an unofficial visit to some of the principal meteorological libraries of Europe and gathered material toward a select bibliography of recent meteorological literature that he has undertaken. This work will aim to present a carefully selected and annotated list of the most useful publications relating to each branch of meteorology, and will greatly facilitate the work of replying to the numerous requests for bibliographic information which are received from the observers of the Weather Bureau, from authors, and from teachers and students planning courses in meteorology.

The librarian, Mr. Herbert H. Kimball, has brought the library of the Weather Bureau up to a higher standard of use and effectiveness than it has heretofore attained. He has also performed the duties of supervising examiner in all matters pertaining to examinations for promotion, and has maintained a series of observations in solar radiation, during the year, he being especially trained and well fitted for this latter important duty.

METEOROLOGICAL RECORDS.

The routine work of checking the receipt of the various meteorological reports, the examinations of the daily, monthly, and annual summaries rendered by the numerous regular and cooperative observers of the Bureau, the preparation of the usual tables, charts, and other matter for the Monthly Weather Review and the Annual Report (quarto volume), furnishing information upon weather subjects to private individuals, public institutions, for use in courts, etc., and tabulating in the permanent records of the Bureau the more important meteorological data from the various points of observation have all been promptly done in the Division of Meteorological Records.

Correspondence with individuals and companies desiring information as to the climate of various portions of the country has largely increased over previous years, about one thousand five hundred such requests having been received during the past twelve months.

Many of these requests can be answered by forwarding to the applicants copies of the publications of the Bureau, but numerous others required the copying and collating of data from the original reports.

On account of the numerous requests for information, especially as to rainfall, from certain localities now being rapidly settled, it has been found convenient to have printed, short extracts for representative districts, giving for each detailed information regarding its salient climatic features. Similar extracts for other important localities will be prepared as the demands require.

NEW SYSTEM OF NORMALS.

During the past ten years the meteorological data of pressure, temperature, and vapor tension have been revised by Professor Bigelow, with a view of reducing them to homogeneous systems. The result of this work on barometry was published in 1902, and the data contained therein form the basis for the reduction to sea level of the barometer readings which appear on the daily weather maps. The recomputation of the temperature data, and the determination of normals referred to a 33-year record are now complete and ready for publication.

The vapor tension normals will be finished during the current year. Daily normals of the temperature, and also of the rainfall, have been furnished to all stations for use in climatological studies.

MONTHLY WEATHER REVIEW.

The Monthly Weather Review is regularly published, and the Chief of Bureau has to acknowledge the kindness of those meteorologists who have contributed excellent articles, such as the following:

"The Mount Rose weather observatory", by Prof. J. E. Church, jr., of the University of Nevada.

"The meteorological optics of Prof. J. M. Pernter", by Prof. R. W. Wood, of Johns Hopkins University.

"Variations in temperature over a limited area", by Prof. W. I. Milham, of Williams College.

"The zodiacal light", by Prof. Arthur Searle, of Harvard University.

"The direction of local winds as affected by contiguous areas of land and water", by T. H. Davis.

"A rare cumulus cloud of lenticular form", by H. H. Clayton.

"The formation of anchor ice", by Prof. H. T. Barnes, of McGill University.

"The difference of temperature between Mount Royal and McGill College Observatory", by Profs. C. H. McLeod and H. T. Barnes.

"The Adirondack rainfall summit", by R. E. Horton.

"The growth of fog in unsaturated air", by F. W. Proctor.

"Rainfall and outflow above Bohio, in the valley of the Chagres", by Gen. H. L. Abbot.

"Rainfall and run-off of the Catskill Mountain region", by Thaddeus Merriman.

"The temperature in anticyclones", by H. H. Clayton.

"The meteor of March 14, 1906, over central New York", by Prof. H. A. Peck, of Syracuse University.

"A proposed new method of weather forecasting", by H. H. Clayton.

"The depression in the solar radiation", by Ladislas Gorczynski.

Among the new features in the Monthly Weather Review has been the addition of the regular chapter on "Ocean Meteorology", by the chief of that division, formerly Mr. James Page, now Mr. H. L. Heiskell.

Among the special contributions by Weather Bureau officials may be mentioned:

"Climatology of Porto Rico from 1867 to 1905", by W. H. Alexander.

"The relation of the weather to the flow of streams", by F. H. Brandenburg.

"Phenomenal rainfall at Guinea, Va.", by E. A. Evans.

"Suggestions as to teaching the science of the weather", by J. Warren Smith.

"The study of practise forecasting", by J. L. Bartlett.

"Salton Sea and the rainfall of the Southwest", by Prof. A. J. Henry.

"Villard's theory of the aurora", by W. R. Blair.

In order that men at stations may be kept informed of the progress of meteorology outside the Weather Bureau, the librarian contributes to the Review monthly lists of additions to the Weather Bureau library, and of papers bearing on meteorology, while the assistant librarian contributes reviews of the progress of climatology.

Owing to the great stimulus recently given to the study of earthquakes, the Monthly Weather Review has published a number of articles by Prof. C. F. Marvin on that subject.

Prof. F. H. Bigelow has continued the publication of his studies on the waterspout in Vineyard Sound.

The West Indian hurricane of September, 1906, that was so destructive at Pensacola and Mobile, has been treated by Prof. E. B. Garriott.

Mr. W. J. Bennett has published an article on the harmonic analysis of the diurnal variation of pressure at Washington, D. C.

Mr. C. F. von Herrmann has presented a series of problems in meterology, with their solutions, which has been highly appreciated by those engaged in educational work; and also an article on the velocities of centers of high and low pressure in the United States.

Prof. H. J. Cox has contributed an account of his visits to meteorological services in Europe.

As the Monthly Weather Review goes to all regular and cooperative observers of the Bureau, and also to those who in exchange send their own publications to the library, its circulation is slowly increasing. Its usefulness is evidenced by the desire exprest on all sides to obtain complete sets of this publication. A small collection of back numbers is held for use in exchanges, for the purpose of securing rare meteorological works for the Weather Bureau library.

Work on a general index of the Monthly Weather Review, including also meteorological items in the annual reports and other publications, has progressed as fast as practicable in the hands of Mr. Stetson and Mr. Mills, and the work is now so nearly completed that the manuscript will be transmitted for publication in a few weeks.

An elaborate report on the formation of frostwork and ice, by Mr. W. A. Bentley, is now being revised by the author, preparatory to its publication at an early date.

Inasmuch as the Monthly Weather Review goes to all the technical meteorologists of the world, and as there is no equivalent medium of communication among English-speaking meteorologists, and as it is necessary to stimulate the study and solution of many most difficult problems in the physics of the atmosphere, it has been thought proper to occasionally allow the publication of highly technical papers that are offered. Meteorology may be lookt at from a statistical, climatological point of view; or, again, with an eye to its relation to agriculture and other human industries; but it is fundamentally a study of the laws that govern atmospheric phenomena, and it is necessary for the Weather Bureau to encourage and assist researches that are directed toward the establishment of these laws, as distinguished from those superficial ideas which are so prevalent, and which exaggerate the influence of the moon and stars, the Gulf Stream, the cultivation of the soil, and many other matters that are of minor importance in meteorology.

THE TEACHING OF METEOROLOGY.

A steady increase of interest in meteorological education is manifest thruout the country, as, in fact, thruout other civilized nations. In general, instruction in meteorology is considered as a part of the courses in geology, geography, or physical geography; but in two universities, George Washington and Cornell, courses have been offered in the higher mathematics and physics that constitute the fundamental basis of meteorology.

During 1906 there were fourteen universities, colleges, and scientific schools in which regular courses of instructions were given by Weather Bureau officials, and in five or six more the matter was in abeyance. Also there were at lease forty officials besides those conducting the above mentioned courses who gave occasional lectures or addresses.

TELEGRAPH DIVISION.

The number of miles of telegraph and telephone lines operated by the Weather Bureau remains the same as at the close of last year; viz, 537, inclusive of about 96 miles of submarine cables.

As during former years, these lines rendered valuable services in obtaining aid for shipping in distress, in reporting inbound and outbound vessels to owners, maritime associations, etc., and by affording in most cases to residents of isolated places and others the only means of telegraphic communication. This latter feature was forcibly brought to notice by the loss of the steamer *Larchmont* near Block Island on the night of February 11, 1907, which involved the loss of about 150 lives. The Weather Bureau cable from Block Island to the mainland furnished the only available telegraph facilities to the survivors for communicating with relatives and friends, and to the press for giving prompt information to the public. Nearly 34,000 words of press matter were cabled from the island in connection with this disaster.

The Hatteras and Nantucket sections also serve as important connecting links between wireless and commercial telegraph systems.

A new submarine cable, 1½ miles long, was laid across Oregon Inlet, N. C., on July 24, 1906, under the supervision of the chief of the Telegraph Division. The old cable across the inlet had a bad leak in its insulation, and was so heavily sanded that it could not be repaired.

On August 26, 1906, the submarine telephone cable between Charlevoix and Beaver Island, Mich., was broken and badly damaged by the steamship *Illinois*, belonging to the Northern Michigan Transportation Company. The chief of the Telegraph Division repaired the cable on September 6, 1906

No extensive repairs to land lines were necessary during the year, nor are any contemplated for the coming year, except on the Tatoosh Island line where it is hoped that the work now under way will materially increase the efficiency of this important, but exceedingly difficult section to maintain.

The Government receipts from all lines for commercial messages handled during the year amounted to $3,393.18.

PRINTING.

The printing of the Monthly Weather Review, Daily Weather Maps, National Weather Bulletins, Snow and Ice Charts, and the regular forms, has continued as heretofore.

The work of printing and wrapping blank station maps, forecast cards, and rural free delivery slips, the greater portion of which has previously been done at the Government Printing Office, was, during the year just closed, performed exclusively in the Weather Bureau printing office.

In compliance with Executive Orders, all mailing lists have been thoroly "purged" and revised, and such publications as have a price affixt, except blank weather maps, have been turned over to the superintendent of documents.

EXAMINATIONS FOR PROMOTION.

Under this heading, in my last annual report, reference was made to the faulty grammatical construction very generally found in essays submitted in connection with the examination in English grammar. So many of the younger employees failed to present satisfactory essays, that it was decided to advance this test from the first to the second grade of examinations. Commencing with the examinations of May, 1907, essay writing, therefore, appears as a separate subject. Employees who have not had the advantages of thoro training in English composition will not be barred from promotion to the $1,000 grade, but they will be expected to satisfactorily meet the required grammatical tests before receiving further advancement.

The following table gives the number of examination papers marked during the year:

Number of employees examined.

Subject.	1906.		1907.		Total.	Past.	Failed.
	Sept.	Nov.	Feb.	May.			
English grammar	9	9	20	7	45	35	10
Arithmetic	4	9	9	3	25	20	5
Elementary meteorology	7	6	9	4	26	20	6
Algebra	3	4	7	2	16	14	2
Physics	2	2	6	6	16	11	5
Trigonometry	5	1	3	2	11	9	2
Essay writing	......	......	......	3	3	3	0
Astronomy	......	......	3	3	6	6	0
Plant physiology	......	1	2	2	5	5	0
Advanced meteorology	1	......	3	1	5	5	0
Total	31	32	62	33	158	128	30

NEW STATIONS.

The bill making appropriation for the support of the Weather Bureau for the fiscal year beginning July 1, 1907, makes no provision for the establishment of additional weather stations, this provision, which was included in the bills for previous years, having been eliminated by Congress. There is, however, a large demand for these stations, and many communications are on file in the Weather Bureau petitioning for their establishment. In many cases the results to be secured would not justify the expense on the part of the Government; in others large agricultural, commercial, and marine interests would largely profit. Stations might advantageously be located at the following-named places: Corinth, Miss.; Fort Wayne, Ind.; Lansing, Mich.; Mount Washington, N. H.; Pikes Peak, Colo.; Sandy Hook, N.J.; Wallace, Idaho; Houston, Tex., and Sitka, Alaska.

OBSERVATORY BUILDINGS.

Forty-eight Weather Bureau observatory buildings are owned by the Government, including the group of nine buildings at Mount Weather, Va. Most of these buildings have been erected or remodeled during the past ten years, and are well adapted for meteorological purposes. The exceptions are small buildings on Mount Washington, N. H., and at Kittyhawk, N. C. The former has not been occupied in recent years and is now in a dilapidated condition, but it is likely that observations on Mount Washington may be resumed, in which event this building may be used by the contractor while a suitable building is being erected. The building at Kittyhawk was formerly used as a telegraph and repair station on the Government telegraph line extending between Cape Henry and Cape Hatteras. It is little more than a shack and is of practically no value, but it serves as a shelter for parties engaged in repairing the telegraph line.

The following table shows where the Weather Bureau buildings are located, and gives the cost of the buildings and grounds:

Buildings owned by the Weather Bureau.

Location.	Cost of ground.	Cost of buildings.	Total cost.
Amarillo, Tex	$1,255.00	$6,503.00	$7,758.00
Anniston, Ala	1,799.75	13,060.69	14,860.44
Atlantic City, N. J	(a)	5,991.00	5,991.00
Bentonville, Ark	500.00	5,119.90	5,619.90
Birmingham, Ala	(b) 61.50	16,129.56	16,191.06
Bismarck, N. Dak	(a)	10,085.99	10,085.99
Block Island, R. I	1,034.50	7,668.25	8,702.75
Burlington, Vt	(b) 20.00	10,043.50	10,063.50
Cape Henry, Va	(a)	9,222.45	9,222.45
Charles City, Iowa	3,036.75	9,565.08	12,601.83
Columbia, S. C	3,799.00	9,165.00	12,964.00
Devils Lake, N. Dak	2,209,05	7,431.50	9,640.55
Duluth, Minn	2,041.70	7,430.68	9,472.38
Hatteras, N. C	(a) (e) 217.00	4,889.75	5,106.75
Havre, Mont	1,795.00	5,087.08	6,882.08
Iola, Kans	2,241.25	9,777.64	12,018.89
Jupiter, Fla	(a)	6,346.90	6,346.90
Key West, Fla	2,020.00	7,994.75	10,014.75
Kittyhawk, N. C	(a)	1,616.00	1,616.00
La Crosse, Wis	3,523.50	12,323.33	15,846.83
Modena, Utah	(a)	4,346.00	4,346.00
Mount Weather, Va.:			
Administration building (including tower and tank)	1,863.15	20,971.12	22,834.27
Power house and balloon building	650.00	8,167.00	8,817.00
Absolute building	(a)	7,000.00	7,000.00
Variation building	(a)	8,904.55	8,904.55
Stable	(a)	1,900.00	1,900.00
Barn	(a)	900.00	900.00
Cottage for workmen	(a)	1,300.00	1,300.00
Physical laboratory	(a)	27,083.89	27,083.89
Cottage and office	(a)	6,800.00	6,800.00
Mount Washington, N. H	(c)	300.00	300.00
Nantucket, Mass	(d)	4,728.53	4,728.53
Narragansett Pier, R. I	4,151.75	8,036.50	12,188.25
North Head, Wash	(a)	3,820.13	3,820.13
North Platte, Nebr	(d)	3,818.50	3,818.50
Oklahoma, Okla	(b) 38.90	10,520.25	10,559.15
Peoria, Ill	(b) 54.00	7,875.50	7,929.50
Point Reyes Light, Cal	(a)	2,875.00	2,875.00
Port Crescent, Wash	102.00	730.94	832.94
Sand Key, Fla	(a)	5,593.00	5,593.00
Sault Sainte Marie, Mich	(a)	2,994.12	2,994.12
Sheridan, Wyo	2,021.75	12,087.40	14,109.15
Southeast Farallon, Cal	(a)	5,211.22	5,211.22
Springfield, Ill	(a)	10,236.50	10,236.50
Tatoosh Island, Wash	(a)	5,000.00	5,000.00
Washington, D. C	(d)	174,950.79	174,950.79
Yellowstone Park, Wyo	(a)	11,156.00	11,156.00
Yuma, Ariz	(a)	1,500.00	1,500.00
Total	34,435.55	524,258.99	558,694.54

a Government reservation. *b* Donated—figures represent cost of title transfer. *c* Leased. *d* Building and ground purchased as a whole. *e* Additional ground purchased.

It will be noted that at several places the buildings were erected on Government reservations; at others on ground donated to the Government.

New buildings recommended.—I am of the opinion that the construction of observatory buildings should be continued until one is located at each of the principal stations of the service, where accurate and reliable observations are so necessary in the preparation of forecasts and warnings, and in supplying accurate meteorological data to large commercial communities. Their advantage over office buildings and public buildings, whose architecture in most cases unfits them for a satisfactory exposure of meteorological instruments, can not be gainsaid, and their maintenance per annum will not materially exceed the rental cost of offices in private buildings, and in many cases be less. It is not desirable that all of the observatory buildings that are required be erected at one time. The work can be done to better advantage if a few are erected each year. I am of the opinion that observatories should be erected in the near future at the following places:

Abilene, Tex,; Cheyenne, Wyo.; Cleveland, Ohio; Columbia, Mo.; Fort Wayne, Ind.; Lansing, Mich.; Mount Washington, N. H.; Neah Bay, Wash.; Pikes Peak, Colo.; Sandy Hook, N. J.; Sitka, Alaska; Houston, Tex., and in the vicinity of St. Paul and Minneapolis, Minn.

Rented buildings.—At certain stations where observatory buildings are not owned by the Government, and where it seemed advisable in the interests of efficient service, a small building or a suite of rooms have been rented in order to secure office space and living quarters for the observers. This is economical to the Government and results in better service, because the rent paid in most instances is less than the cost of office rooms in business blocks, the salary paid to an official provided with living quarters is less than would be given him if such quarters were not furnished, and good exposures for instruments are obtained.

Mount Weather buildings.—The construction of buildings at Mount Weather, Va., was exhaustively investigated during the year by the House Committee on Expenditures in the Department of Agriculture, by whom the scope of the work being carried on at that place was considered. A summary of the committee's report is contained in Report No. 8147, Fifty-ninth Congress, Second Session; it concludes as follows:

> The discretion as to where the stations are to be located is left with the Secretary of Agriculture. All the law and precedents seem to us, therefore, to fully justify the Secretary of Agriculture in everything that he has done in regard to the establishment of Weather Bureau stations and in regard to the erection of buildings for the accommodation of such stations as needed buildings—whether one or more.
>
> * * * * * * *
>
> We are of the opinion that with so much money being annually spent in the making of forecasts and storm warnings, which everyone agrees have a great value to the various industries of the country, it is a wise economy to devote a reasonable amount of money to the carrying on of experimentation at one of the many stations of the Weather Bureau, so that the science that is back of the art of forecasting may be improved, and that thereby the annual expenditures for the support of the Weather Bureau may have a greater value to the people. We find no evidence of extravagance or misapplication of funds in the creation of the institution at Mount Weather, which we believe to have been worthily conceived and the plans so far to have been efficiently executed.

Rented buildings occupied wholly by the Weather Bureau.

Station.	Annual rent.	Other items included.
Alpena, Mich	$650.00	Heat, light, water.
Basseterre, St. Kitts	120.00	One room; observatory platform on cupola; janitor.
Bridgetown, Barbados	120.00	One room; cleaner, water.
Curaçao, W. I	260.00	Three rooms; cleaner, light, water, ice, bridge tolls.
Del Rio, Tex	444.00	Heat, light, water.
Durango, Colo	440.00	Heat, light, water.
East Clallam, Wash	120.00	Water.
Flagstaff, Ariz	300.00	
Helena, Mont	504.00	Steam heating plant, water.
Honolulu, Hawaii	1,020.00	Six rooms; heat, cleaner, light, janitor and porter service, electric current for fan, storage.
Independence, Cal	360.00	Water.
Kalispel, Mont	360.00	
Lewiston, Idaho	540.00	
Manteo, N. C	144.00	
Moorhead, Minn	600.00	Heat, light, water.
Mount Tamalpais, Cal	420.00	Heat, light, water, free transportation of Government employees and supplies.
Pysht, Wash	144.00	Water.
Roseburg, Oreg	550.00	Heat, light, water.
Roswell, N. Mex	720.00	Heat, cleaner, water
San Juan, P. R	684.00	Four rooms; light, water.
Santo Domingo, W. I	240.00	Five and one-half rooms.
Thomasville, Ga	420.00	
Tonopah, Nev	1,200.00	
Twin, Wash	108.00	Water.
Williston, N. Dak	510.00	Heat, cleaner, light, water.
Winnemucca, Nev	360.00	Heat, light, water.
Total	$11,338.00	

The physical laboratory building and the cottage and office building at Mount Weather, Va., included in the list, are not completed, and further work on them is dependent upon appropriation by Congress for this purpose. The walls of the physical laboratory building are completed, the roof and metal cornice work nearly finished, the window sashes are on the ground but not in place, and a small part of the pipes for the heating apparatus is installed. The porch, exterior painting, platform, grading, and all of the interior work, including plumbing, stairway, wiring, decorating, etc., remain undone. It will require about $12,000, exclusive of furnishings, machinery, and apparatus, to complete this building. The cottage and office building is under roof and all exterior work except the porches and the painting is done. The interior work is partly done. The trimming, painting, plastering, decorating, and the installation of the plumbing fixtures are unfinished. The heating pipes are in place and the boiler and radiators on hand ready for installation. The material for the stairway, trimming, plastering, etc., is at hand. It will require about $3,000 to complete the building and grading. I have, therefore, recommended that the sum of $15,000 to complete the two unfinished buildings at Mount Weather, Va., be included in the estimate of appropriations for the next fiscal year.

Observatories under construction.—The list also includes observatories at Anniston, Ala., Birmingham, Ala., Charles City, Iowa, Iola, Kans., La Crosse, Wis., and Sheridan, Wyo., which are in course of construction and will be completed by September 15, 1907.

Need for observatory buildings.—Experience during the past thirty years has demonstrated the value of observatary buildings in the work of the Weather Bureau. They provide for the taking of meteorological observations under favorable and unchanging conditions. Records thus obtained are of prime value for utilitarian purposes and indispensable to research. In cities where the Government does not own observatory buildings the offices are located in Government buildings or in rented quarters. It is difficult to obtain suitable exposure for meteorological instruments in such buildings because they were not designed for meteorological purposes, and frequent removals are necessary owing to the erection nearby of taller buildings and for other causes which interfere with even a fair exposure for instruments. Each change breaks the continuity of the records in so far as uniformity of conditions is concerned, and makes comparison difficult, if not impossible. The observatory buildings owned by the Government are designed for the peculiar needs of the work of the Bureau, and they are located on plats of ground of sufficient size to insure satisfactory exposure for years to come. Their value, however, is not confined to securing reliable observations. They contain office rooms well located and adopted for the dissemination of forecasts and information to the public, and living quarters which enable an official to be constantly at hand to care for the automatic recording instruments and respond to the public demands for information. It has been the policy to adjust the salaries of officials occupying these buildings so that the living quarters are part compensation. This plan, while it operates satisfactorily in most cases, has some objectionable features, and it is intended, if Congress renews the appropriation for observatory buildings, to recommend that in the future housekeeping quarters be not included therein, except in buildings located at places where it is impracticable to secure proper accommodations for observers off the Government premises, but that instead one to three rooms be furnished to observers who will be in custody of the premises, look after the automatic instruments, and respond to public calls for information outside of the ordinary office hours. This plan will permit of certain advantageous changes in the architecture of the buildings and probably result in a lessening of the cost of construction. It may be advisable to eliminate the kitchen and dining room features of the buildings now in use as fast as conditions will warrant, and to devote the rooms now used for those purposes to office use.

CHANGES IN THE FORCE OF THE BUREAU.

CLASSIFIED SERVICE.

Appointments:		
Probationary—		
Assistant physicist at $1,400	1	
Pressmen at $1,250	2	
Clerks at $1,000	3	
Printer at $1,000	1	
Clerk at $900	1	
Copyist at $840	1	
Assistant observer at $840	1	
Assistant observers at $720	43	
Repairmen at $720	5	
Fireman at $720	1	
Skilled laborer at $600	1	
Messenger boys at $450	7	
Skilled laborer at $450	1	
Messenger boys at $360	34	
		102
Transfer—		
Research observer at $1,400	1	
Research observer at $1,200	1	
Assistant observer at $1,000	1	
Printer at $1,000	1	
		4
Reinstatement—		
Printer at $1,000	1	
Messenger at $600	1	
		2
Under Sec. 3, Rule 2, Civil Service Act and Rules—		
Expert in vessel reporting at $840		1
Temporary—		
Compositors at $1,250	3	
Clerks at $1,200	2	
Skilled mechanic at $1,000	1	
Clerk at $1,000	1	
Printers at $1,000	2	
Clerk at $900	1	
Repairmen at $720	2	
Folder and feeder at $720	1	
Skilled laborer at $450	1	
Messenger boys at $360	31	
		45
Emergency—		
Pressmen at $1,250	2	
Compositors at $1,250	3	
Clerk at $1,200	1	
Clerk at $1,000	1	
Copyist at $840	2	
Firemen at $720	3	
Folder and feeder at $720	1	
Messenger at $600	1	
Skilled laborers at $600	2	
Skilled laborer at $450	1	
Messenger at $450	1	
		18
Promotions.		
(All promotions were to the next higher grade or by certification for advancement from subclerical positions with one exception wherein a skilled mechanic was promoted from $1,000 to $1,4000 to fill a temporary vacancy)	155	
Reductions:		
Causes—		
To grant assignment to preferred station	1	
To eliminate the $1,500 grade	1	
Neglect of duty	2	
Inability to write climatological reports	1	
Numerous errors in meteorological work	1	
Ineligibility, unknown prior to promotion	1	
Necessitated by next preceding cause	2	
Negligence and irregularity in connection with promotion examination	2	
Necessitated by employee's return to duty from leave of absence without pay	6	
As an offset to Bureau for allowances of quarters, fuel, and light	3	
		20
Resignations:		
Voluntary	82	
Required because of—		
Unsatisfactory services	1	
Unsatisfactory conduct	1	
Unsatisfactory conduct and services	2	
Incompetency	1	
		87
Removals:		
Causes—		
Unsatisfactory conduct and services	3	
Absence without authority	2	
Absence without authority and neglect of official correspondence	1	
False statements in connection with the awarding of a contract, receiving reimbursement from a State government for an account settled by the United States, and insubordination	1	
Insubordination	1	
Wilful neglect of duty	1	
Dropt from the rolls after extended furloughs	2	
		11
Dropt from rolls at termination of probationary period:		
Causes—		
Unsatisfactoay conduct and services	1	
Physical inability to perform work required	1	
		2
Deaths		2

UNCLASSIFIED SERVICE.

Appointments:		
Permanent—		
Unclassified laborers at $600	2	
Unclassified laborers at $480	1	
Student assistants at $300	4	
		7
Promotions:		
(Each to next higher grade)		2
Reductions:		
Cause—		
Necessitated by employee's return to duty from leave without pay		1
Resignations:		
Voluntary		5
Removals:		
Cause—		
Services no longer required		1

ABSENCE.

Average with pay, per employee, during calender year, 1906.

Station.	Sickness.	Annual leave.
(99 per cent males)	1.0 day.	7.6 days.
Washington, D. C.		
Males	3.4 days.	26.1 "
Females	3.6 "	26.8 "
Entire service	1.9 "	12.7 "

STATISTICS OF THE SERVICE.

The following tables show the numerical strength of the Bureau and the highest, lowest, and average salaries paid in the commissioned grades:

Numerical strength of the Weather Bureau, June 30, 1907.

At Washington, D. C.:		
Classified	175	
Unclassified	12	
		187
Outside of Washington, D. C.:		
Classified	502	
Unclassified	13	
		515
Total commissioned employees		702
Additional employees outside of Washington, D. C.:		
Storm warning displaymen	175	
River observers	371	
Cotton region observers	143	
Corn and wheat region observers	133	
Rainfall observers	85	
Sugar and rice region observers	9	
Total noncommissioned employees		916
Total paid employees		[a] 1,618
Persons serving without compensation (except thru the distribution of Government publications):		
Cooperative observers and correspondents (omitting 83 under pay as river and rainfall observers, already enumerated above)	5,311	
Cooperative storm warning displaymen	79	
Total cooperatives		5,390
Total numerical strength		[b] 7,008

Distribution of the commissioned force, June 30, 1907.

In Washington, D. C.:	
Accounts Division	c13
Climatological Division	7
Editor Monthly Weather Review	2
Executive branch	c16
Forecast Division (including River and Flood Service)	14
Division of Ocean Meteorology	9
Instrument Division	10
Library	4
Division of Meteorological Records	17
Miscellaneous Mechanical Work	5
Publications Division	45
Supplies Division	10
Telegraph Division	11
Captain of the Watch (under direction of the Chief Clerk)	6
General messenger and laborer service (under direction of Chief Clerk)	18
Total	187
Outside of Washington, D. C.:	
57 stations with 1 commissioned employee	57
55 stations with 2 commissioned employees	110
37 stations with 3 commissioned employees	111
18 stations with 4 commissioned employees	72
10 stations with 5 commissioned employees	50
9 stations with 6 commissioned employees	54
2 stations with 7 commissioned employees	14
3 stations with 8 commissioned employees	24
1 station with 9 commissioned employees	9
2 stations with 10 commissioned employees	20
1 station with 14 commissioned employees	14
195 stations	d535

a This total embraces all paid persons connected with the Bureau on June 30, 1907, except 20 commissioned employees on leave of absence or furlough without pay on that date for three months or more.

b In the Annual Report for 1906, page 22, fifteenth line, the words "Total numerical strength" should have read "Total unpaid employees", making the total numerical strength 10,188. Also 3,683 "weather correspondents" were serving as "cooperative observers" and were counted twice. The actual numerical sterngth on June 30, 1906, was 6,505.

c One man devotes a portion of his time at the United States Capitol map stations.

d This number represents the normal station force. On June 30, 1907, there were actually on regular duty but 515 employees.

In addition to the foregoing there are 9 special observing (one-man) stations in the West Indies, mainly in operation during the hurricane season, a special observing station in Alaska, and a special repair station in Washington operated from October to April, inclusive.

The following salary table omits persons on duty at special observing and substations—where the salaries are $25 a month or less, and where, as a rule, the tour of duty covers but a small fraction of the day and only certain seasons of the year.

Salaries paid in the commissioned grades.

Grades.	June 30, 1907. Station.	June 30, 1907. Washington, D. C.
CLASSIFIED GRADES.		
Highest salary	$3,000	$5,000
Lowest salary	360	450
Average salary	993	1,204
UNCLASSIFIED GRADES.		
Highest salary	600	720
Lowest salary	300	240
Average salary	378	492

Average salary for all (station and Washington) is $1,025.

It is desired to invite attention to the increasing difficulty of recruiting the outside observing and messenger forces of the Bureau, a condition which if allowed to continue will seriously impair the efficiency of the service. While the total station force has been increased by only 10 per cent since 1904, from 487 to 535, it has been necessary in the observing force alone to increase the yearly appointments by 114 per cent, from 17 to 44, in order to maintain an effective working strength. The separations from the service were about equally divided between new appointees who soon became dissatisfied with the prospects for advancement and older employees who felt obliged to sever their connections with the Bureau in order that they might better their financial conditions. In the case of the observing force the figures reported by the Civil Service Commission as regards examinations show that in the last two years there has been a marked falling off in the number of persons taking the examinations and in the percentage of those passing; while there has been a corresponding increase in the number of appointments from the eligible register. The figures are appended:

	1904.	1905.	1906.[1]	1907.
Examined	214	201	...	180
Past	104	112	...	25
Appointed	17	29	43	44

An additional examination was necessitated in 1907 by the exhaustion of the eligible register. At the present rate of appointing this supplemental register will be exhausted also at an early date, all of the eligibles thereon having been certified and more than one-half appointed as this report goes to press. The mere difficulty of securing eligibles is not, however, the most serious phase of the matter. It will be noticed that in 1904 and 1905 48 per cent and 55 per cent respectively, of those taking the examinations past, while in 1907 but 14 per cent past, and with relatively lower ratings, indicating a marked falling off in the educational qualifications of those taking the examinations, the scope of which remained the same. The situation made evident by the foregoing figures is particularly discouraging, since in a scientific bureau it is of first importance that the ranks be recruited from young men of education and ability, preferably having scientific or technical training. It is apparent that the low salaries and limited opportunities for advancement which the Bureau can offer are preventing these classes from seeking to enter its employ. There is no other bureau of the Government that is so greatly in need of young, alert, and well-educated men.

The difficulties presented in the case of the messenger force are of longer standing. As early as 1904 it was found impossible to hold boys in the service at the small salaries paid—$360 a year for a beginner. Previous to that time it was the custom to order messengers from one station to another, and in filling vacancies certification was often made of boys residing at distant points. It was found that boys could not maintain themselves away from home on the salaries paid, and with the view of relieving the situation it was recommended to the Civil Service Commission and by them approved that future certifications should be made from local eligible lists, to be established when necessary for Weather Bureau appointments alone. It was hoped to secure by these means the services of boys residing at home who would be willing to serve at the low salaries permitted. This method of securing eligibles has been given a thoro trial, but has not effected the relief sought and the situation as regards the messenger force has again become acute. It is of the utmost importance to the public interests that the numerous daily forecast telegrams, cards, and maps of the weather service shall be handled expeditiously, and this can not be done by a messenger force rendered inefficient thru constant changes in the personnel. During the last fiscal year alone there were 34 appointments to fill vacancies in a force numbering, normally, 97.

INCREASE IN SALARIES.

I believe that the salaries paid to officials in charge and to the first assistants at local stations of the Weather Bureau are commensurate with the salaries paid for comparable work by

[1] No examination.

other institutions of the Government and by business firms, but the compensation of observers and messengers in the lower grades is inadequate and insufficient to properly maintain them under the present conditions of high cost of clothing, rents, food, and other necessities of life. The per annum salary formerly paid to assistant observers just entering service was $840, but on my recommendation it was reduced to $720. I believe this to be proper compensation for these new employees, because for six months or more they render but little service, and require much of the time of station officials in teaching them the details of the work and the requirements of the position. Again, they are probationers who are being tested for their general fitness for the work. I believe, therefore, that for the first year of service a salary of $720 per annum is sufficient, but those worthy of retention should be advanced to the next grade—$840 per annum—at the end of one year. These employees are paid from the lump-sum roll, which is carefully and economically apportioned, but the amount available is not sufficient to advance them until after two or more years' service. On July 1, 1907, there were 20 assistant observers receiving the compensation of $720 per annum who had more than one year's service, and who should be promoted. I have therefore recommended that $3,000 be added to the station salary fund to accomplish the advancement of assistant observers after one year of satisfactory service.

The initial salary paid to messenger boys is $360 per annum, and it has not been possible to advance these employes to the next grade—$480 per annum—until after two years' service, often for a longer period. The salary is so small that it does not induce intelligent and ambitious boys to enter the service. Resignations are frequent and result in much annoyance to the officials in charge of local offices. A good, faithful messenger is a valuable employee. He knows the operating details of an office and has many duties that can not be assigned to employes of a higher class. When it becomes necessary to break in a new messenger, it takes up much of the valuable time of higher employees in order to prevent confusion in the office. The salary of the position should be sufficient to content boys for a few years, until they fit themselves for higher duties and are old enough to assume them. There are at present about one hundred messenger boys on duty outside of Washington. Their compensation should be increased, and I have recommended that $12,000 be added to the station salary fund in order to provide promotion of $10 per month for those in the lower salary grades.

Printed weather maps.—Daily weather maps in printed form are issued from 25 stations, and by duplicating process from 81 stations. The latter is not satisfactory, because at best the maps have not a neat appearance, and whenever the issue is in excess of about 150 copies they become blurred and almost illegible. These maps, for which there is a large public demand, should be issued in neat printed form, and in order to accomplish this the services of about 10 additional printers are required. I have recommended that $12,000 be added to the station salary fund for this purpose.

INSTRUCTION OF NEW OBSERVERS.

When the weather service was a military institution, new observers were trained in their duties at a military school located at Fort Myer, Va. Since the abandonment of that school new appointees have been sent direct to various stations of the service where their services were required. Most of the duties of an observer are technical, and it requires considerable time and patience to instruct them in the taking, reducing, and recording of meteorological observations, transmitting reports, making weather charts, and preparing meteorological forms. Experience has shown that whenever new observers are sent to a station, they are not capable of performing the greater part of the office work, but, on the contrary, they cause additional work, and it consumes much of the time of the official in charge, or of a trained assistant, in teaching them their duties. The available force at hand has not been sufficient to make these new employes extras to the regular force of the stations, but almost invariably they take the place of trained employees. This is often embarassing and cause errors and delays in the work, which, under the circumstances, can not be avoided. In large cities and commercial centers where there is a weather station maps are prepared on the floors of local boards of trade and other similar institutions, and the data placed thereon has become a factor in the business transactions of the United States. It is so arranged that the preparation of these maps is begun at the same moment of time in all sections of the country so that there may be no discrimination. It is apparent therefore, that skilled and rapid employees are essential for this work. A slow and inefficient man might give traders in another city the advantage of fifteen to twenty minutes, and, with direct telegraphic communication between the trading institutions in various cities, this advantage is considerable. It has frequently happened that members of a board of trade in one city have received telegraphic weather information from the board in another city before it was recorded on the map in his own institution. Complaints of this kind are justifiable, but the local officials of the Weather Service are obliged to use their limited force to the best advantage, and when they have one or more untrained observers they are not always able to remedy the difficulty at once. Again, the work at the various meteorological stations is interdependent, and delay in the taking and recording of an observation at one results in a corresponding delay at every station at which these reports are received. It will be understood how essential skill, rapidity, and efficiency are to this work when it is remembered that promptly at 8 a. m., seventy-fifth meridian time, observers located in every part of the United States must take observations of all the elements of the weather, make mathematical reductions, record them, and place them on the telegraph wires, so that by 9:30 a. m., or in ninety minutes, these observations may be received at the various stations of the United Stated, recorded on maps, and forecasts and warnings issued therefrom. In the efficient administration of this service there should be a school of instruction where new employees may be thoroly taught their duties, and slow or inefficient ones weeded out, and so make it possible to assign to stations only men who are trained and efficient. The Central Office at Washington is the logical place for this training, because here they may, with little or no additional expense, have practical training in all the lines of work and be under the guidance and instruction of the most expert men of the service. A training of three to six months would be required, and a constantly recruited class of fourteen men would be enough to provide for the exigencies of the service due to deaths, resignations, dismissals, etc. I have recommended that $10,000 be added to the station salary fund for that purpose.

Chart IV. Total Annual Precipitation, 1907.

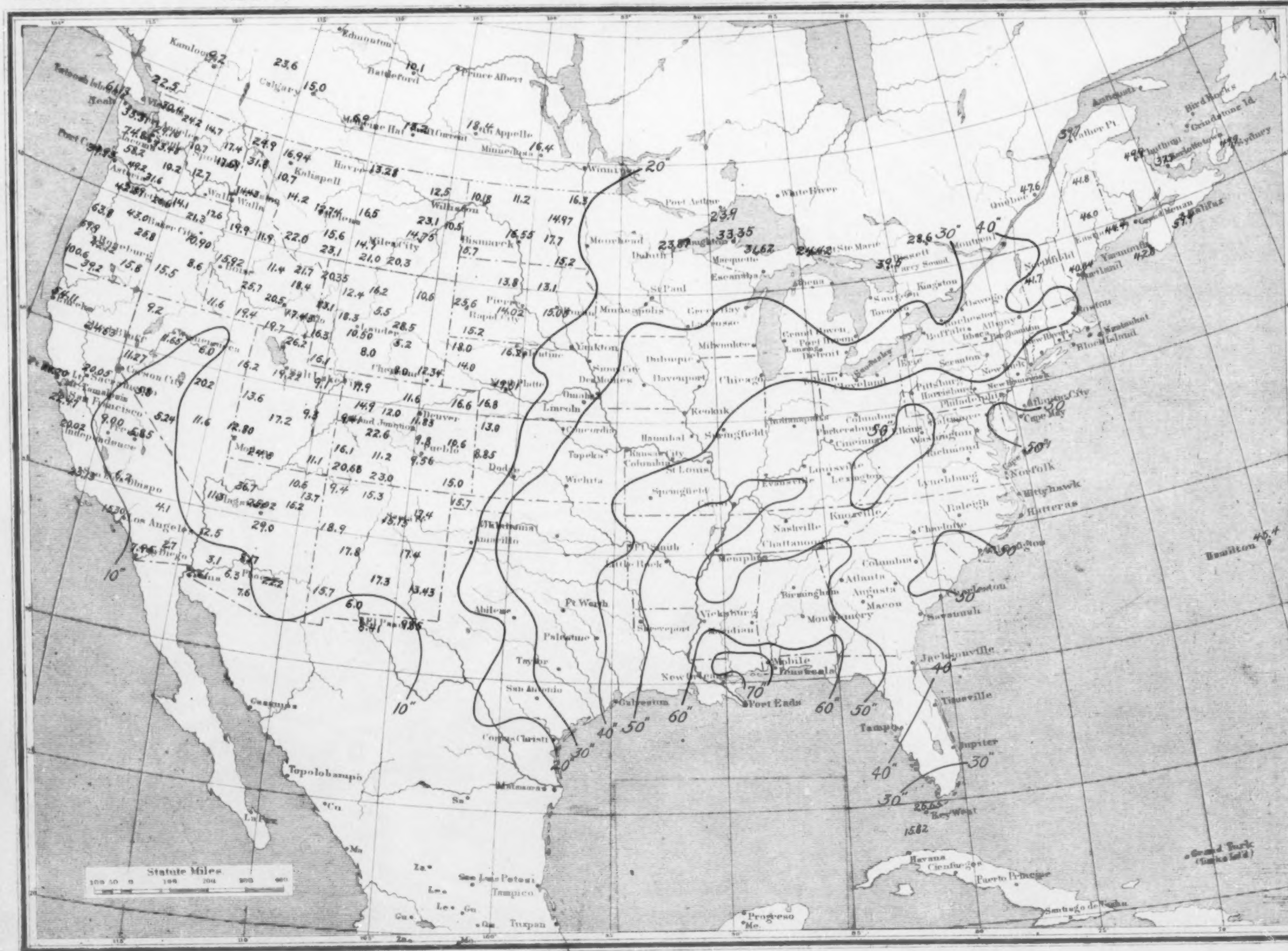


Chart V. Percentage of Clear Sky between Sunrise and Sunset, 1907.

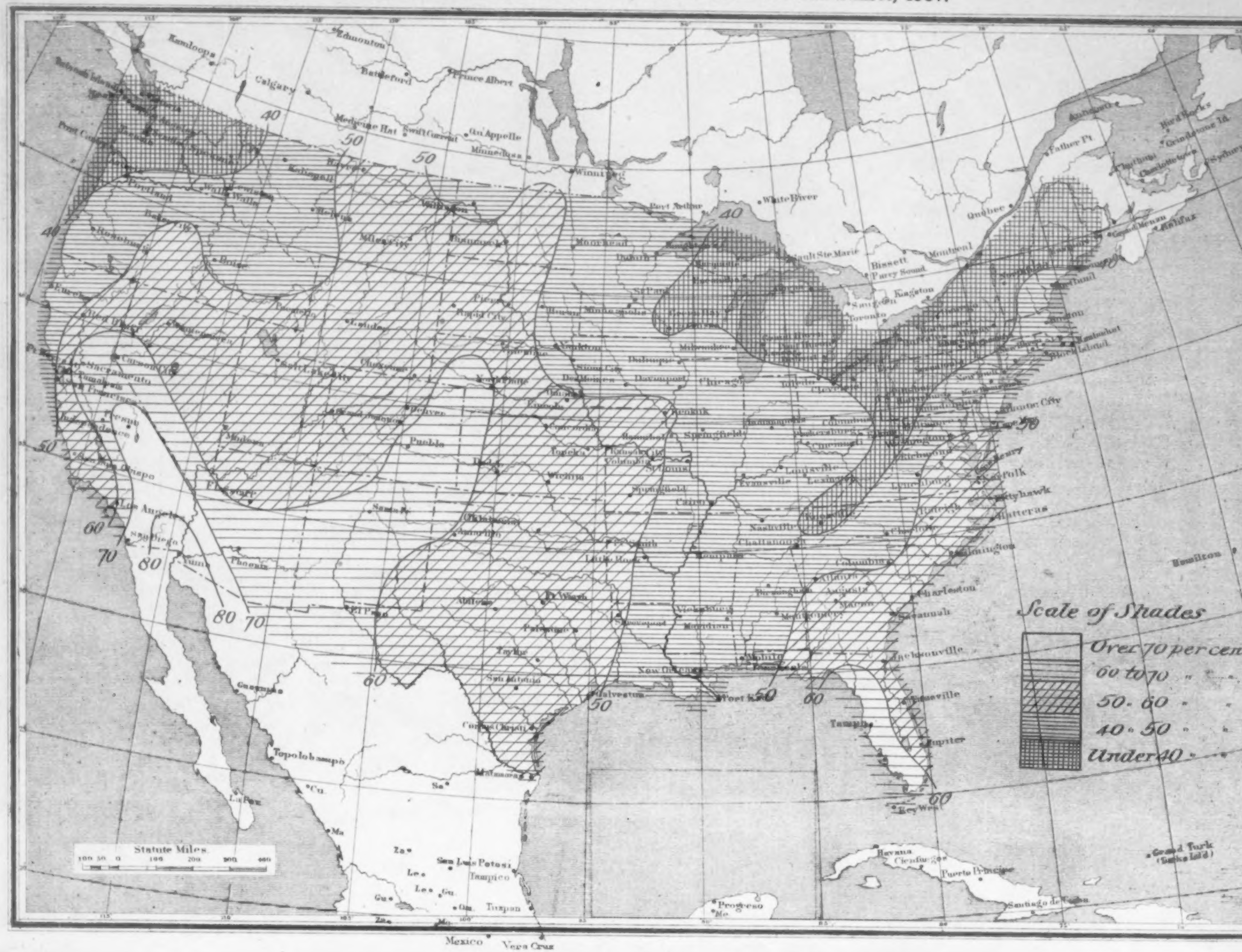
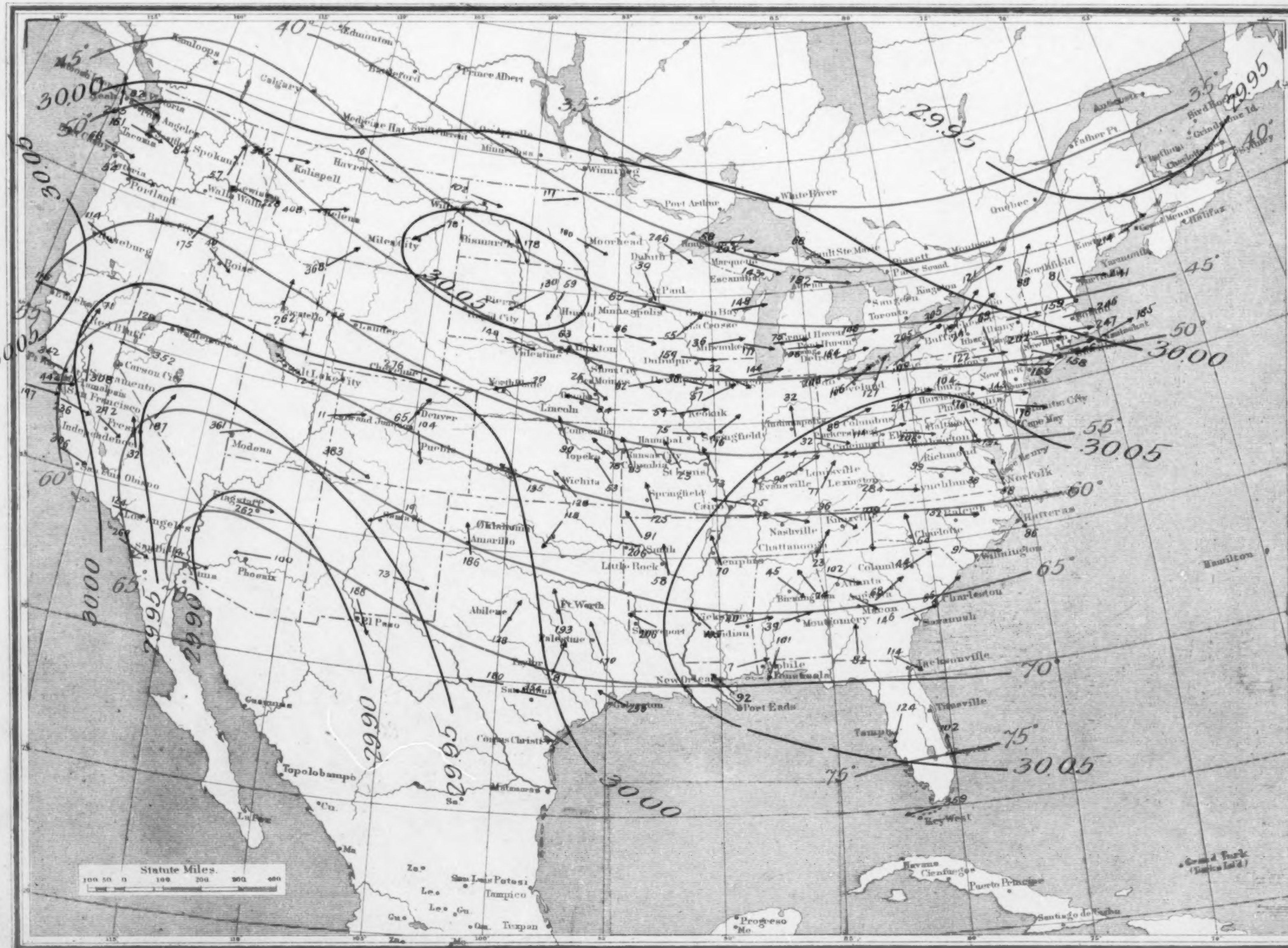


Chart VI. Isobars and Isotherms at Sea Level; Surface Wind Resultants, 1907.



Mexico Vera Cruz

Chart IX. Annual Absolute Maximum and Minimum Surface Temperatures, 1907.

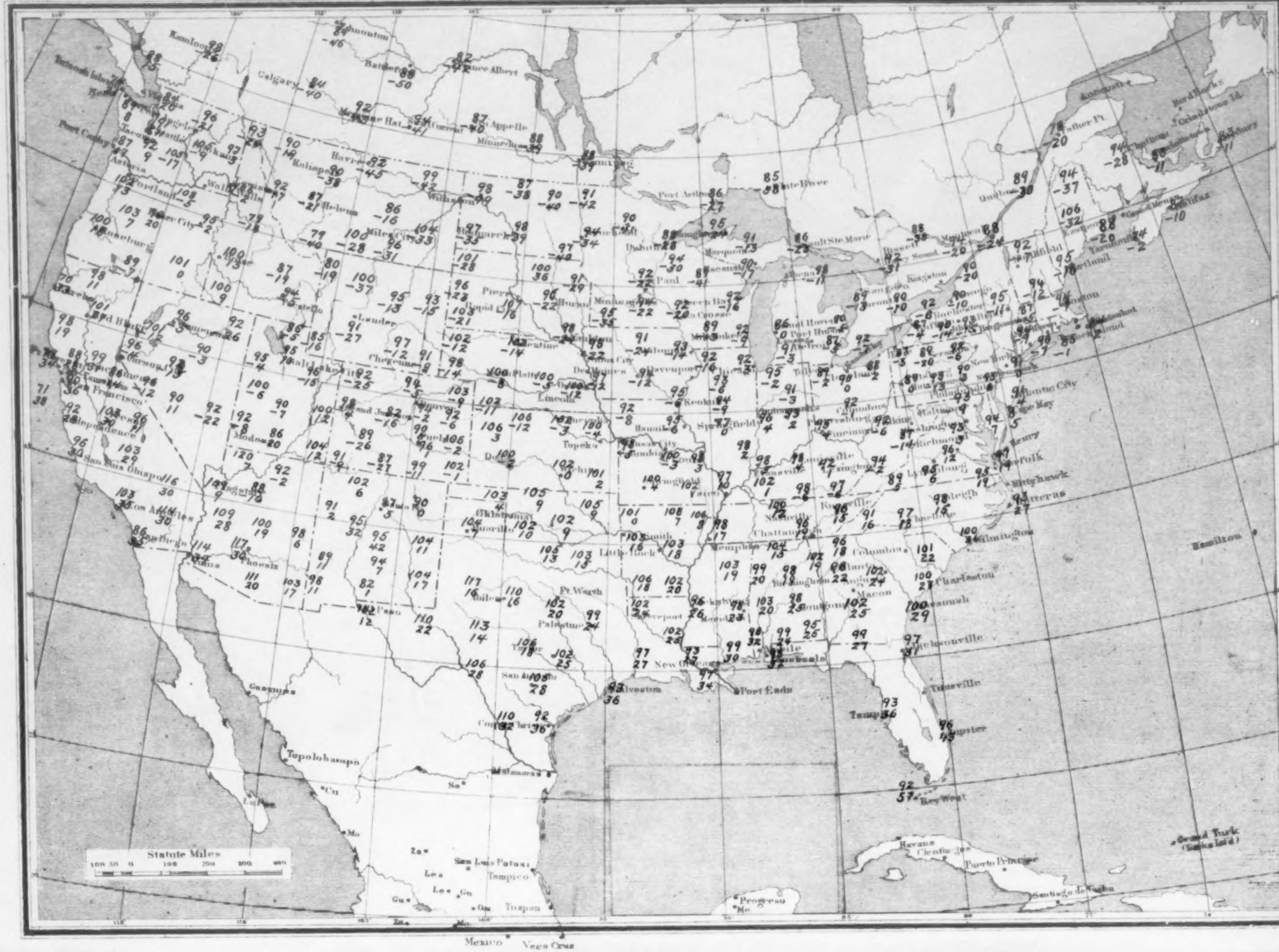


Chart X. Total Number of Thunderstorm Days, 1907.

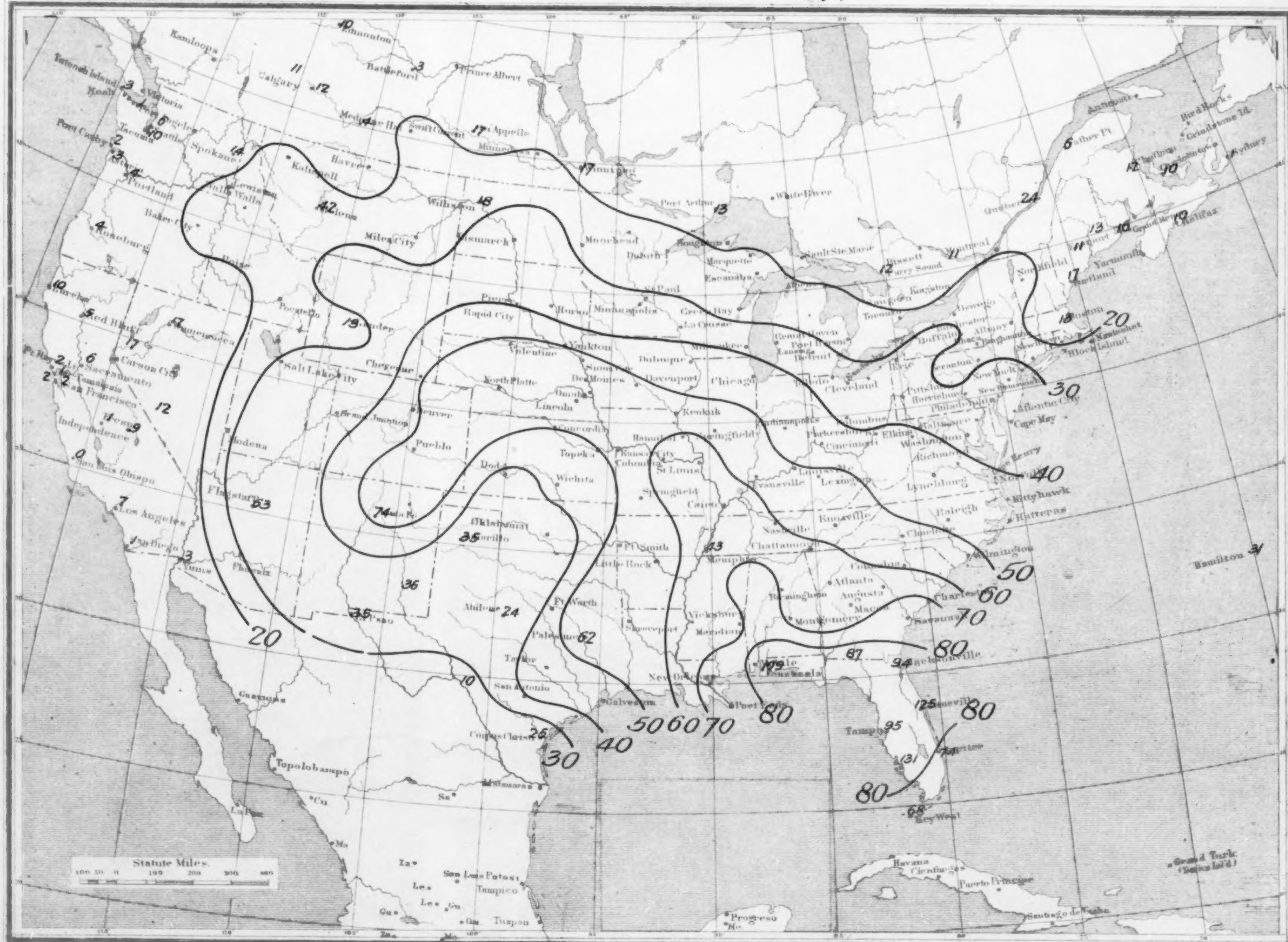
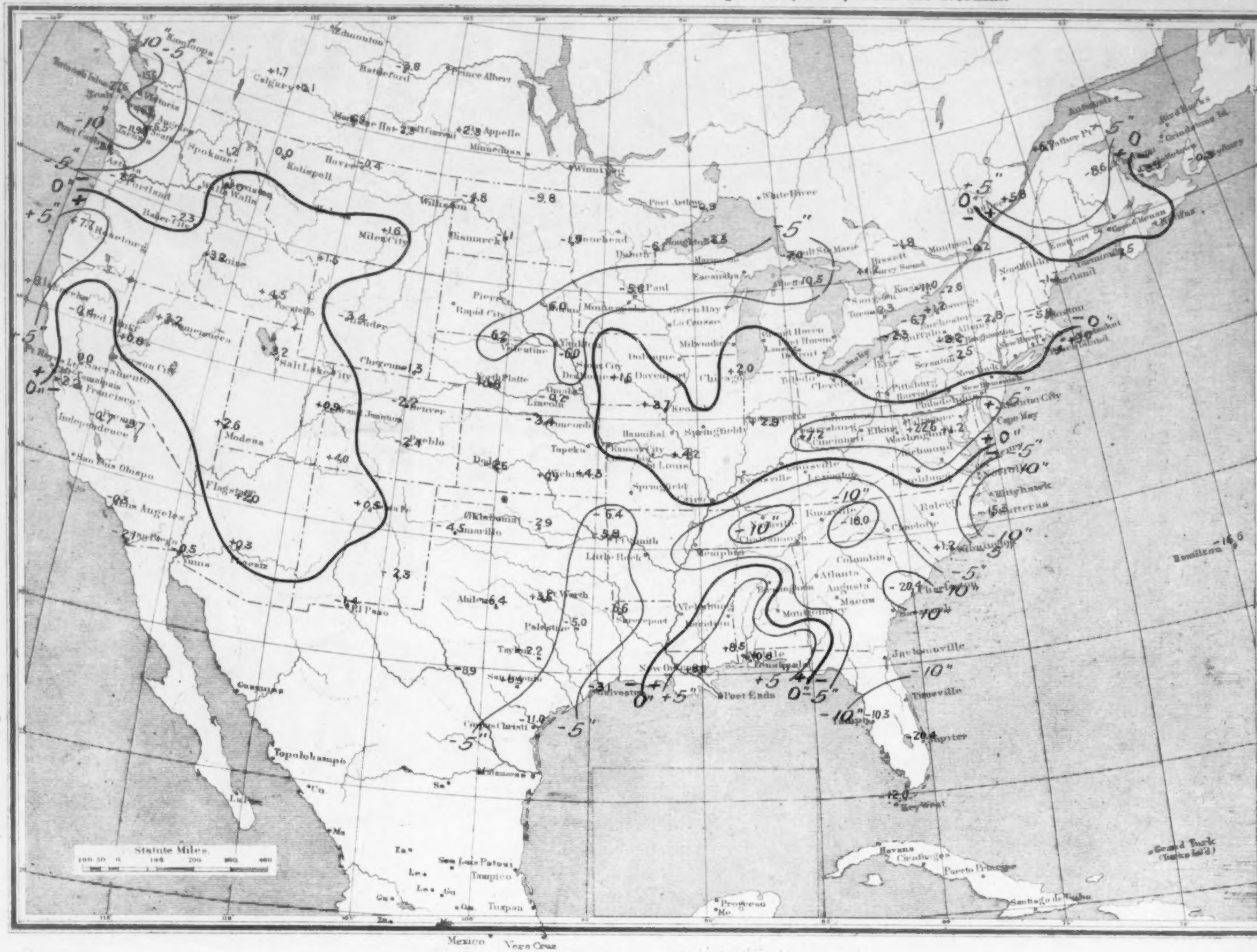
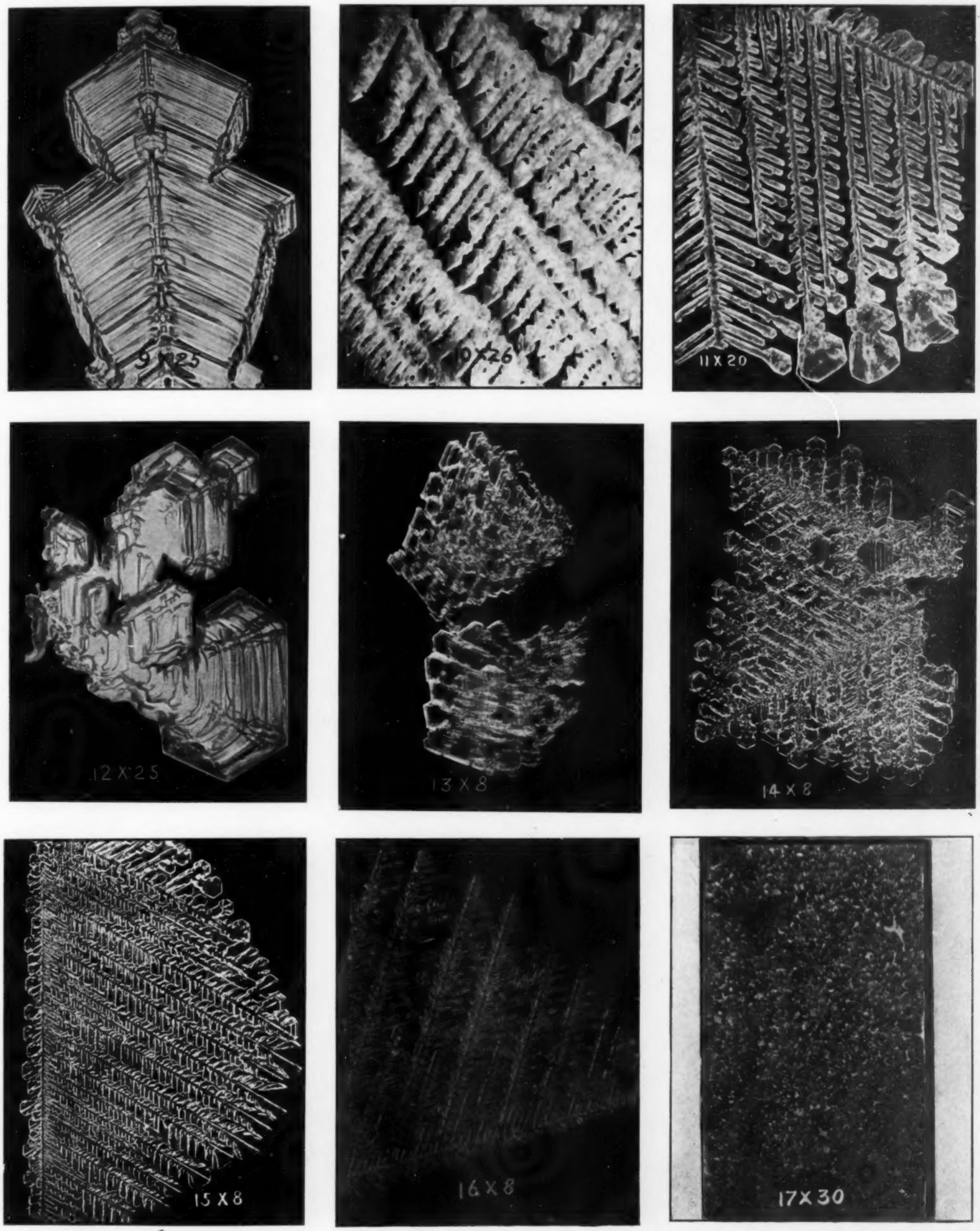


Chart XI. Departure of the Total Annual Precipitation, 1907, from the Normal.

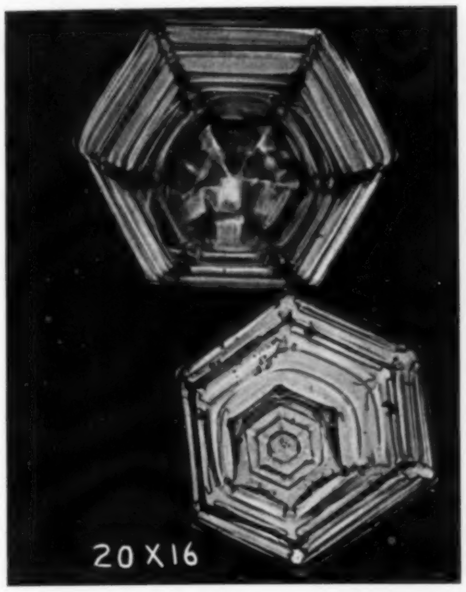


Photomicrographs of Frost and Ice Crystals.

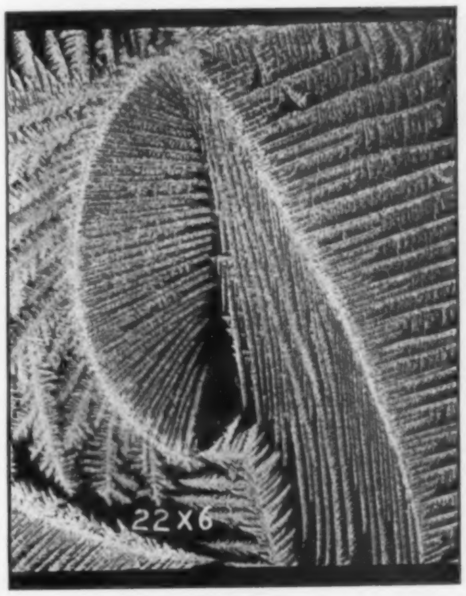
Plate I.



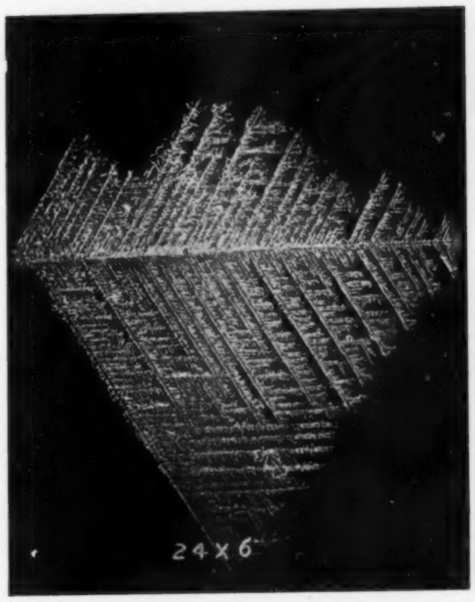
9 X 25
10 X 26
11 X 20
12 X 25
13 X 8
14 X 8
15 X 8
16 X 8
17 X 30


20 X 16

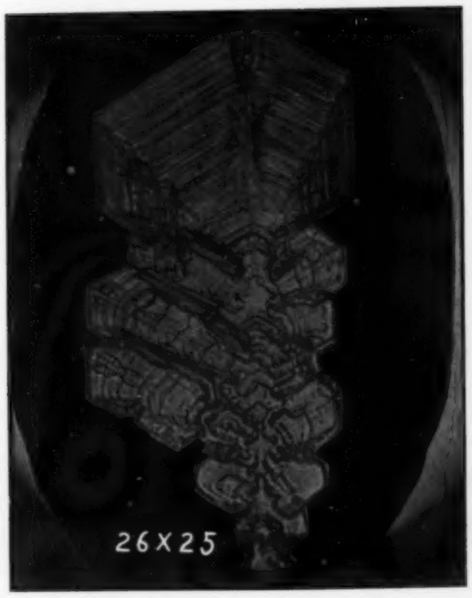

21 X 8


22 X 6

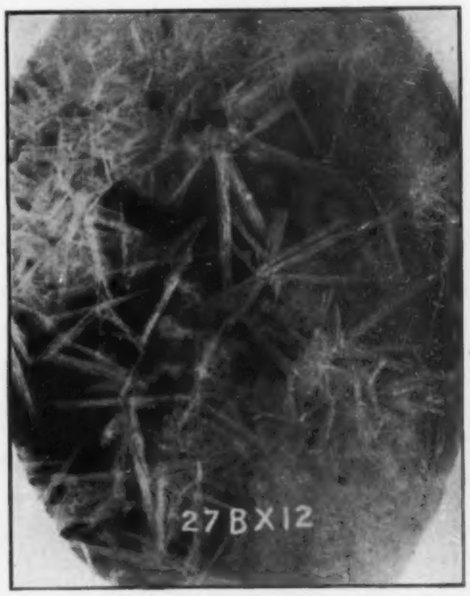

23 X 6

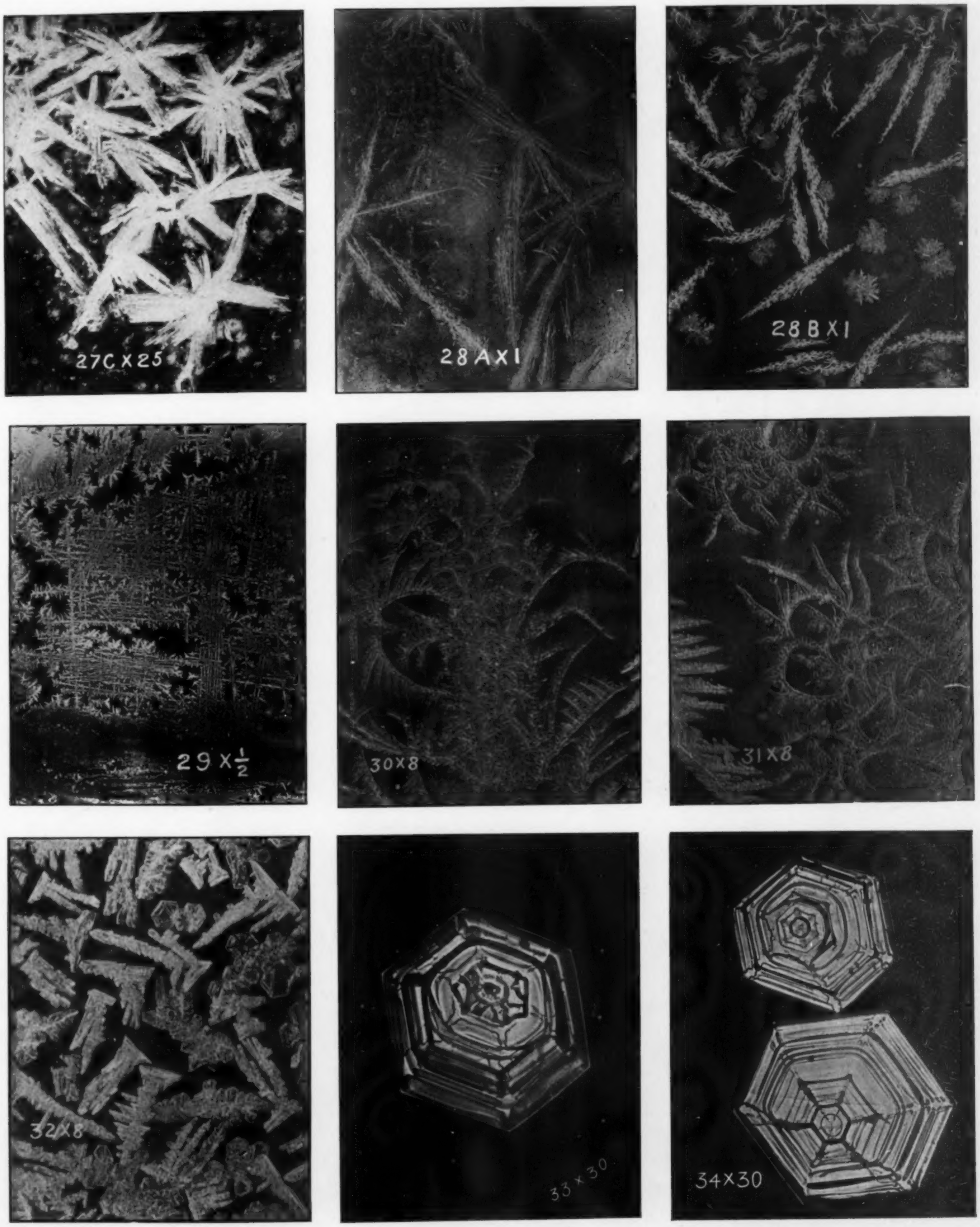

24 X 6


25 X $\frac{1}{3}$

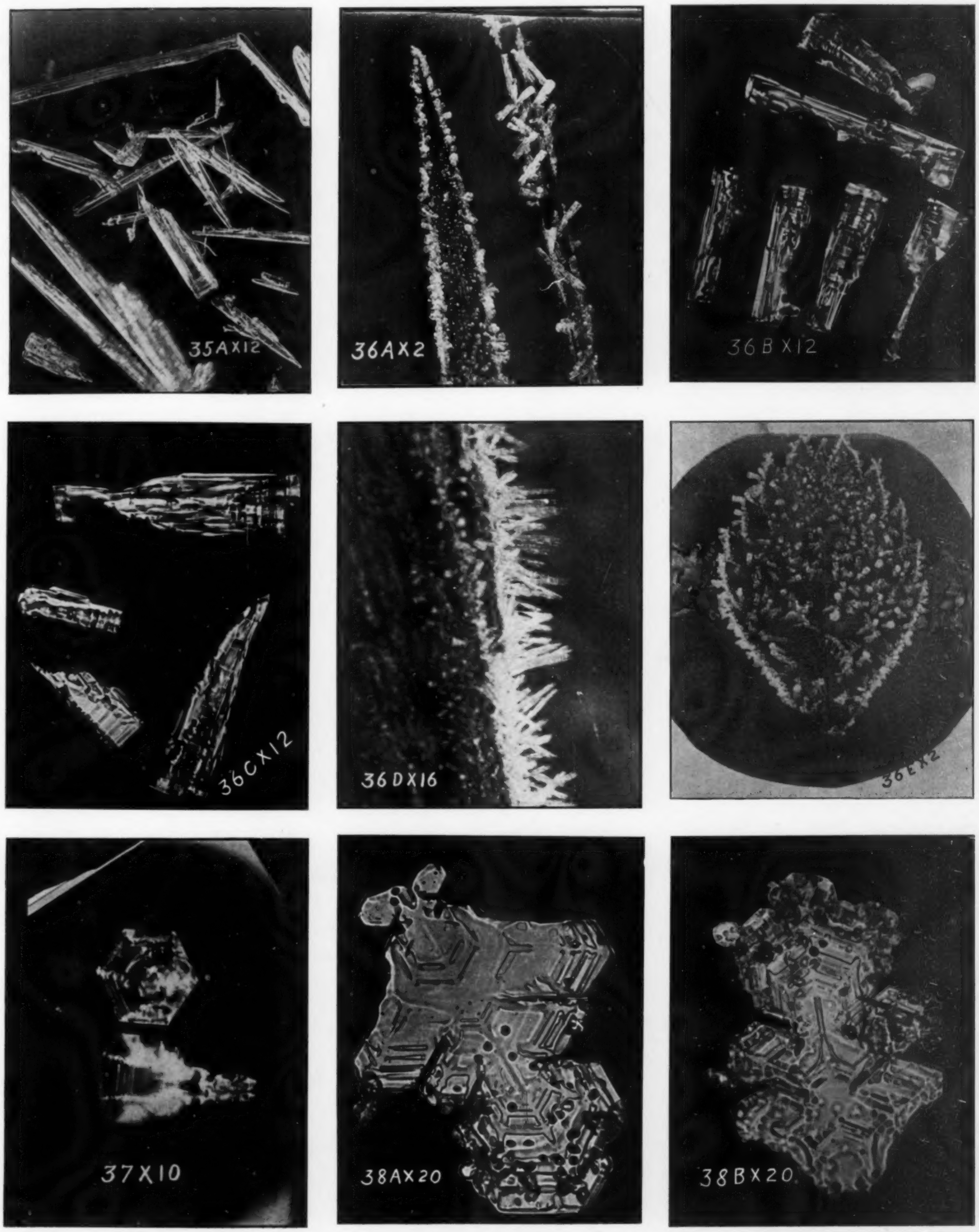

26 X 25


27 A X 24


27 B X 12

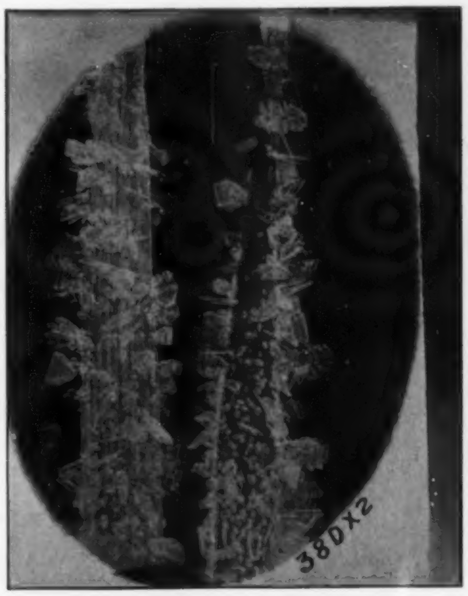

27C X25
28 A X1
28 B X1
29 X 1/2
30X8
31X8
32X8
33 x 30
34X30

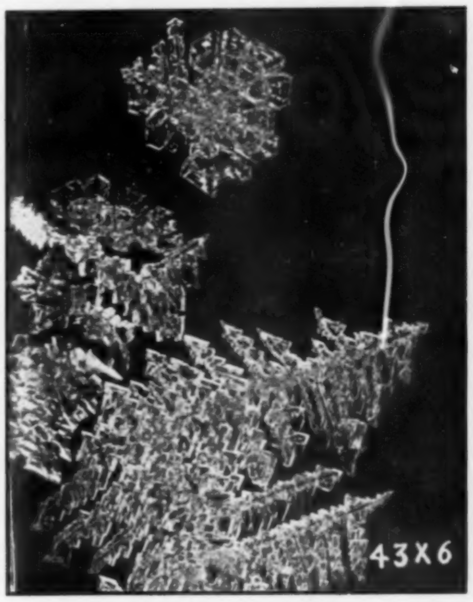
Photomicrographs of Frost and Ice Crystals. Plate V.

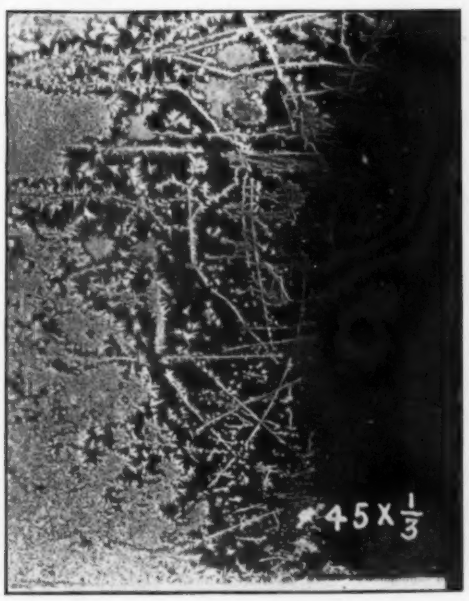


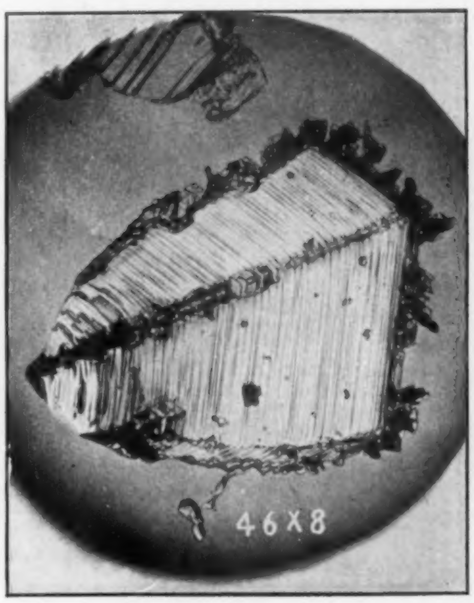
Photomicrographs of Frost and Ice Crystals.

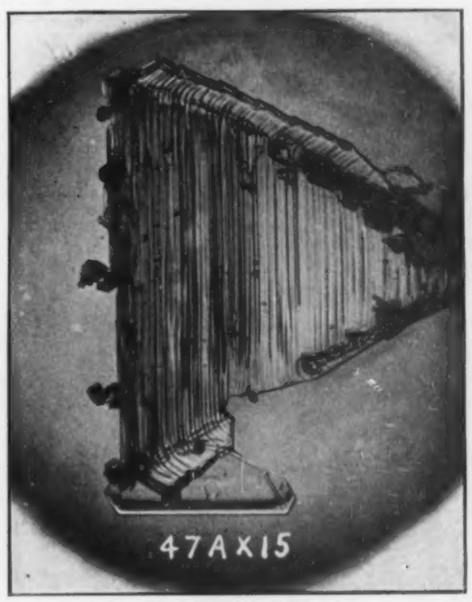
Plate VI.

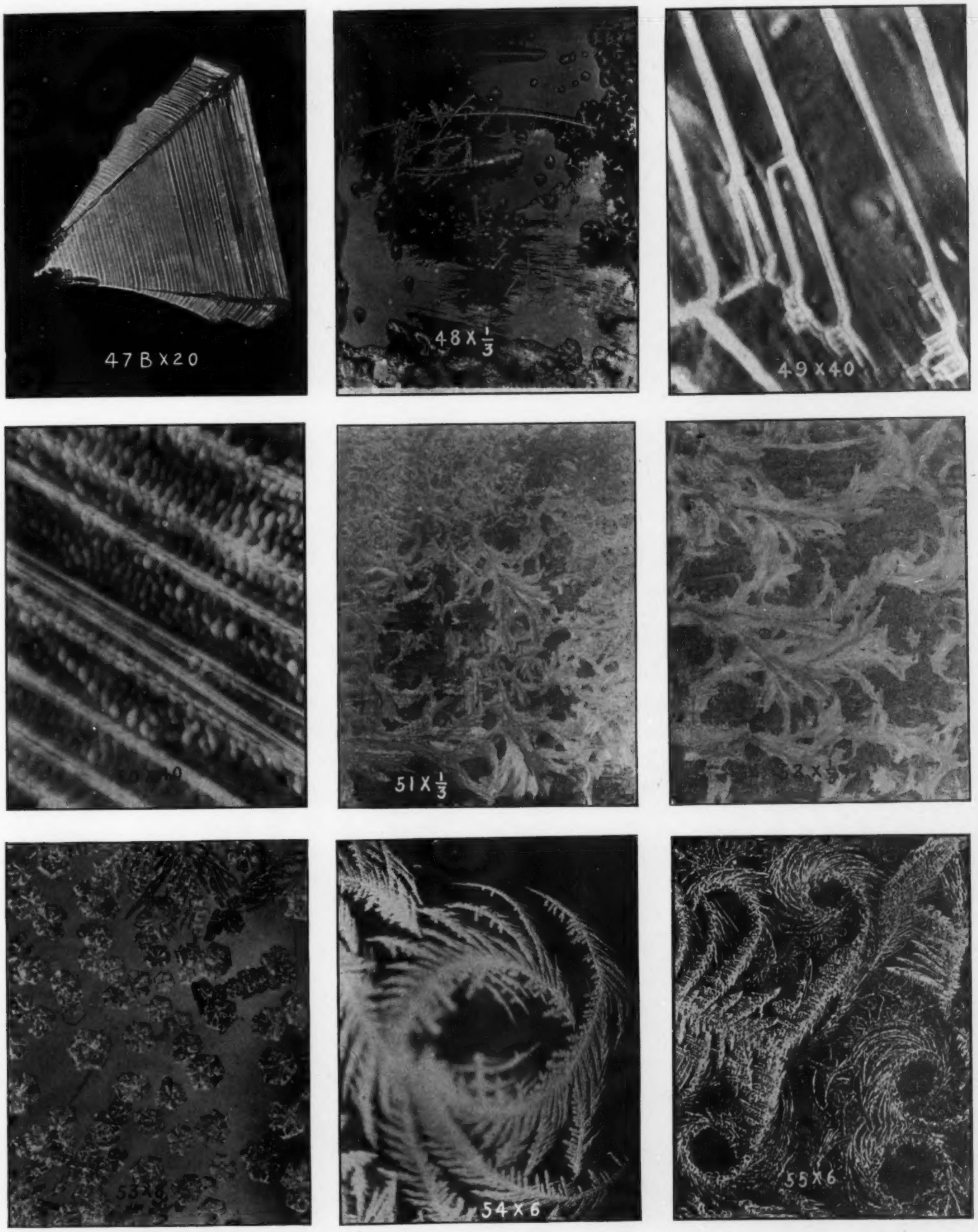










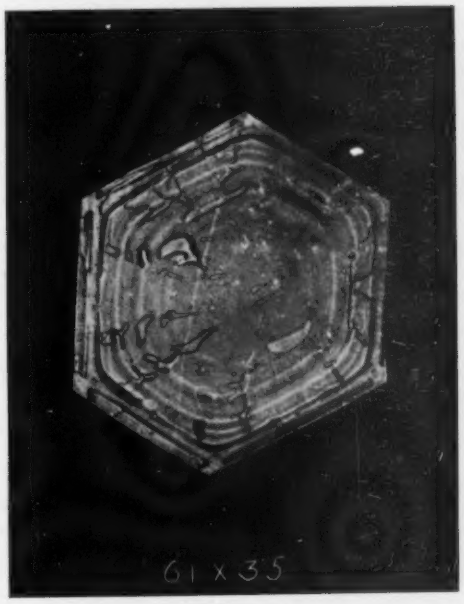

47 B X 20
48 X 1/3
49 X 40
51 X 1/3
54 X 6
55 X 6


56 X 6


58 B X 6

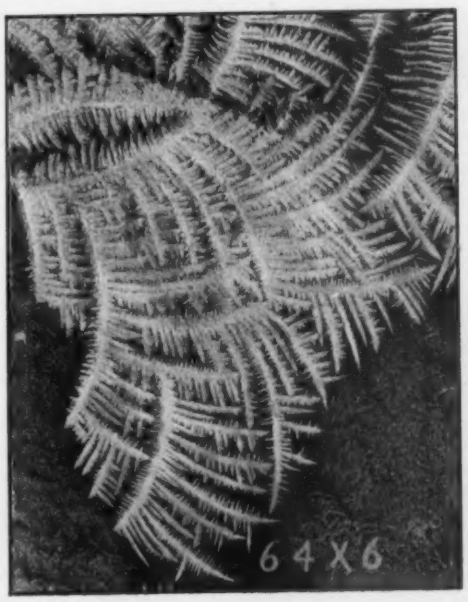

59 X 8


60 X 8


61 X 35

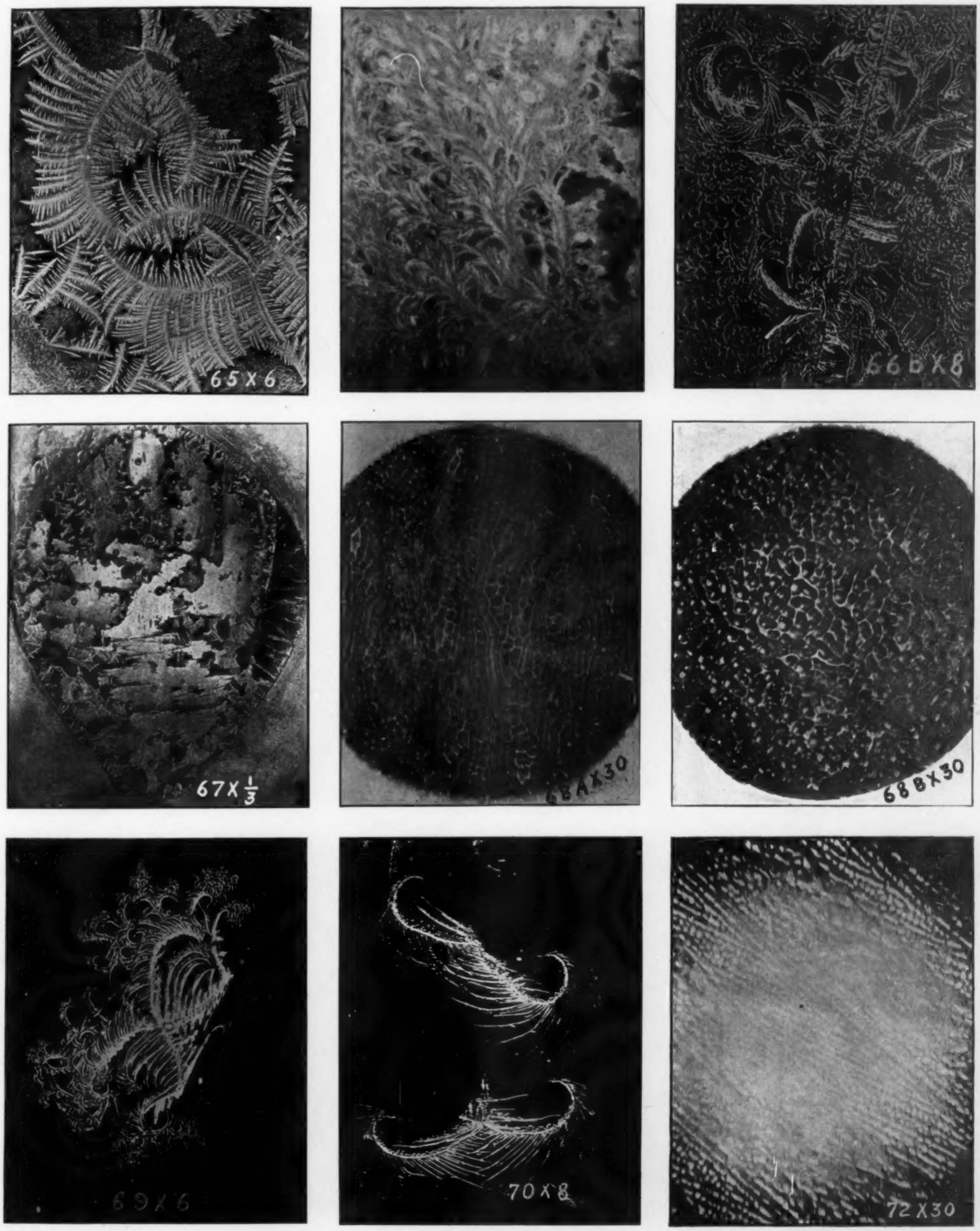

62 X 60

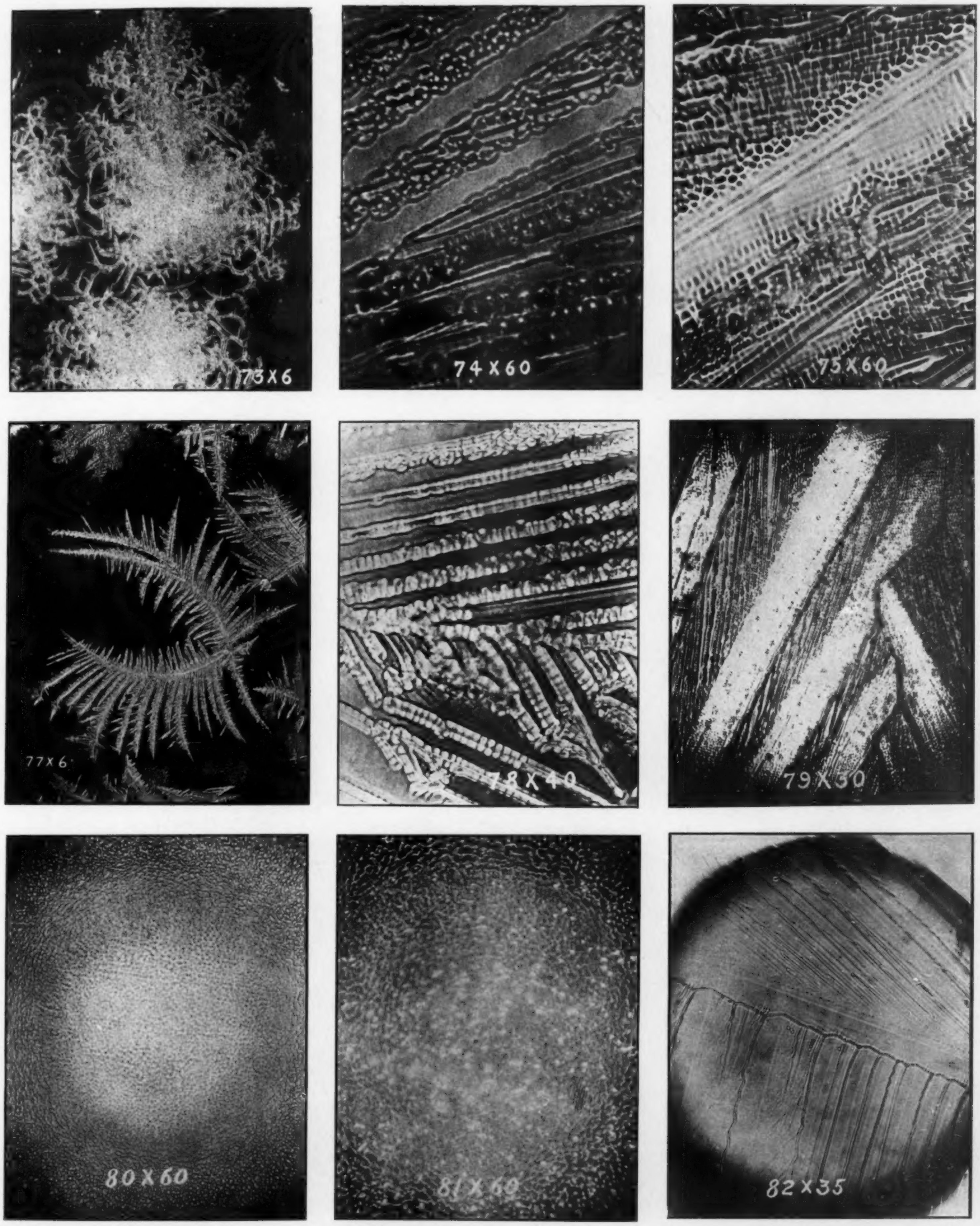

63 X 1/3


64 X 6

Photomicrographs of Frost and Ice Crystals.

Plate IX.




73X6
74X60
75X60
77X6
78X40
79X30
80X60
81X60
82X35


83X30


85X8


87X20

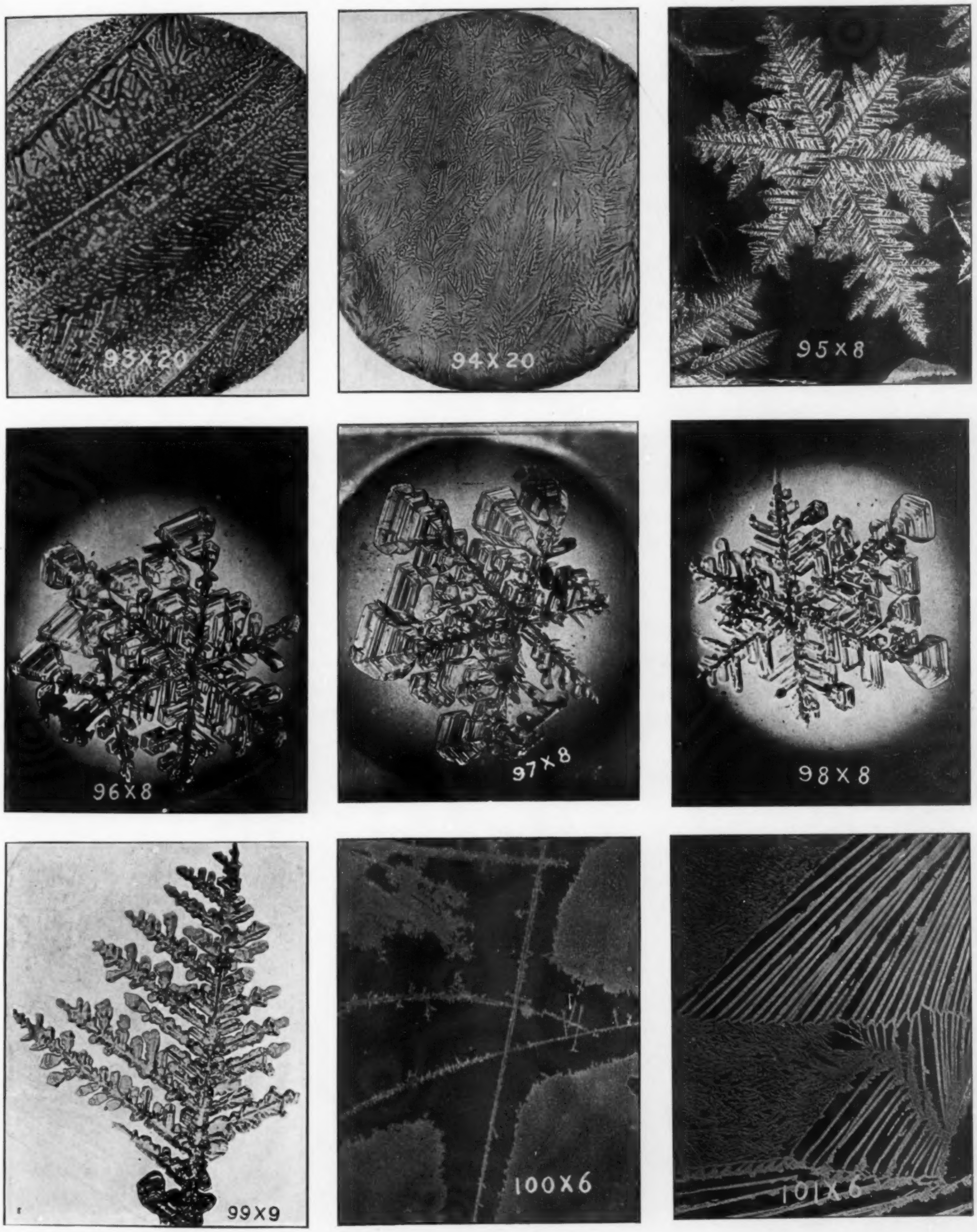

88X25


89X25

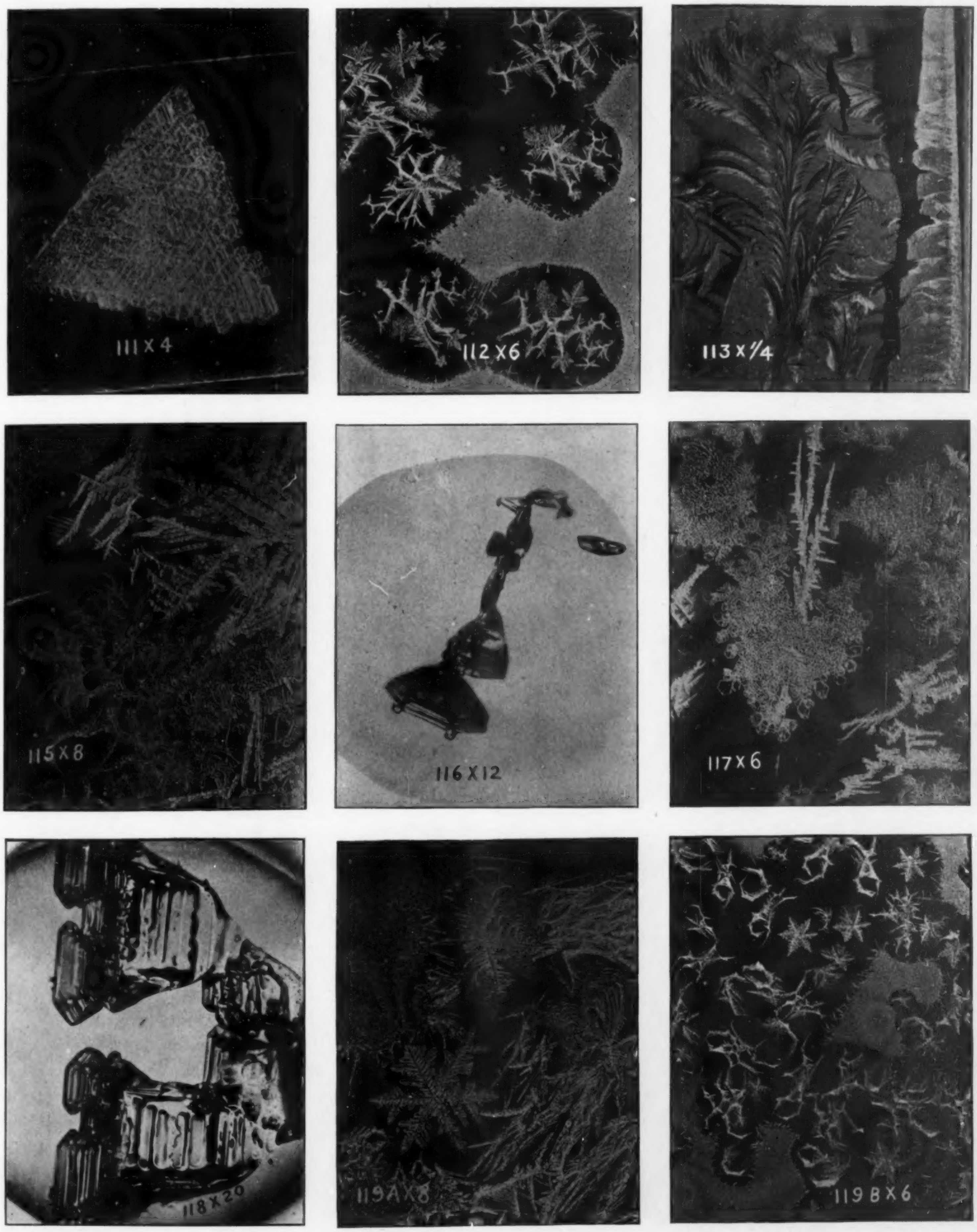

91X$\frac{1}{3}$


92 X 25

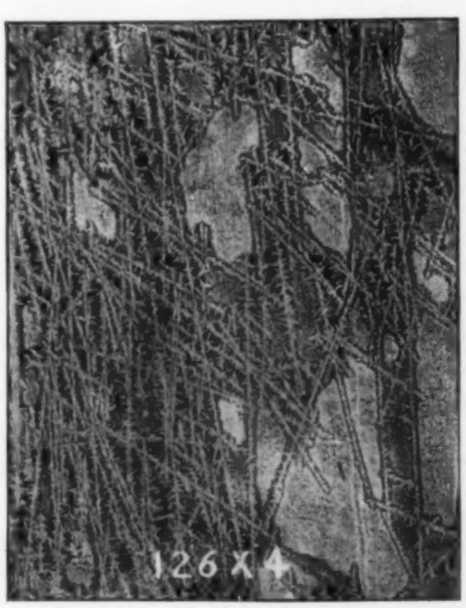
Photomicrographs of Frost and Ice Crystals.

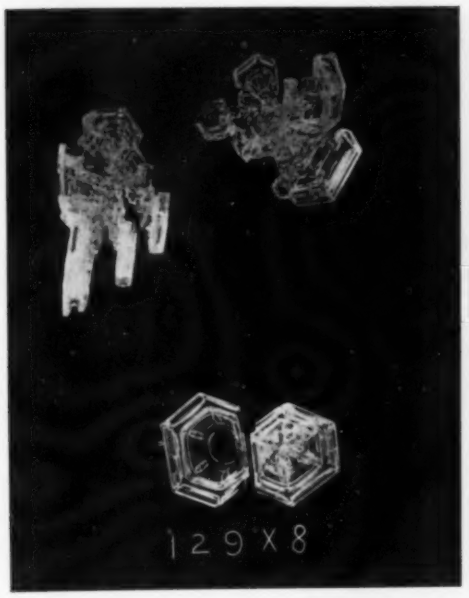



102 X 8
103 X 8
104 X 6
105 X 6
106 X 8
107 X 6
109 X 6
110 X 4


111 X 4
112 X 6
113 X 1/4
115 X 8
116 X 12
117 X 6
118 X 20
119 A X 8
119 B X 6

Photomicrographs of Frost and Ice Crystals.

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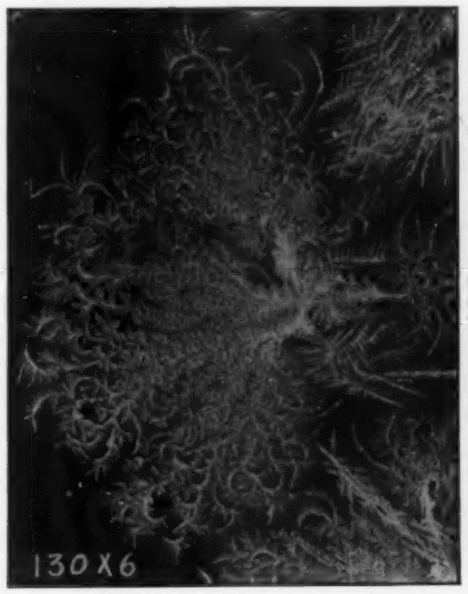
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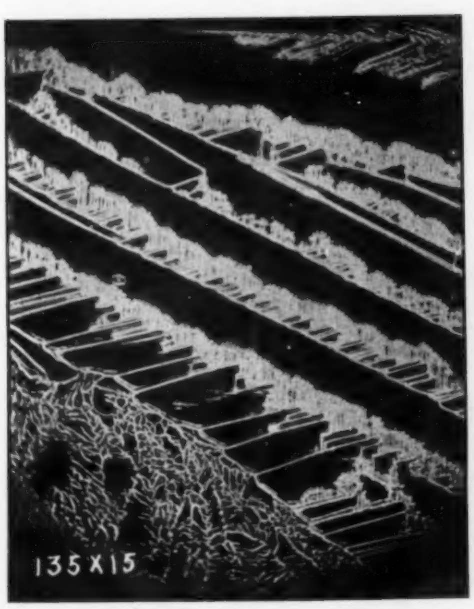
131 X 6


132 X 6


133 X 15


134 X 15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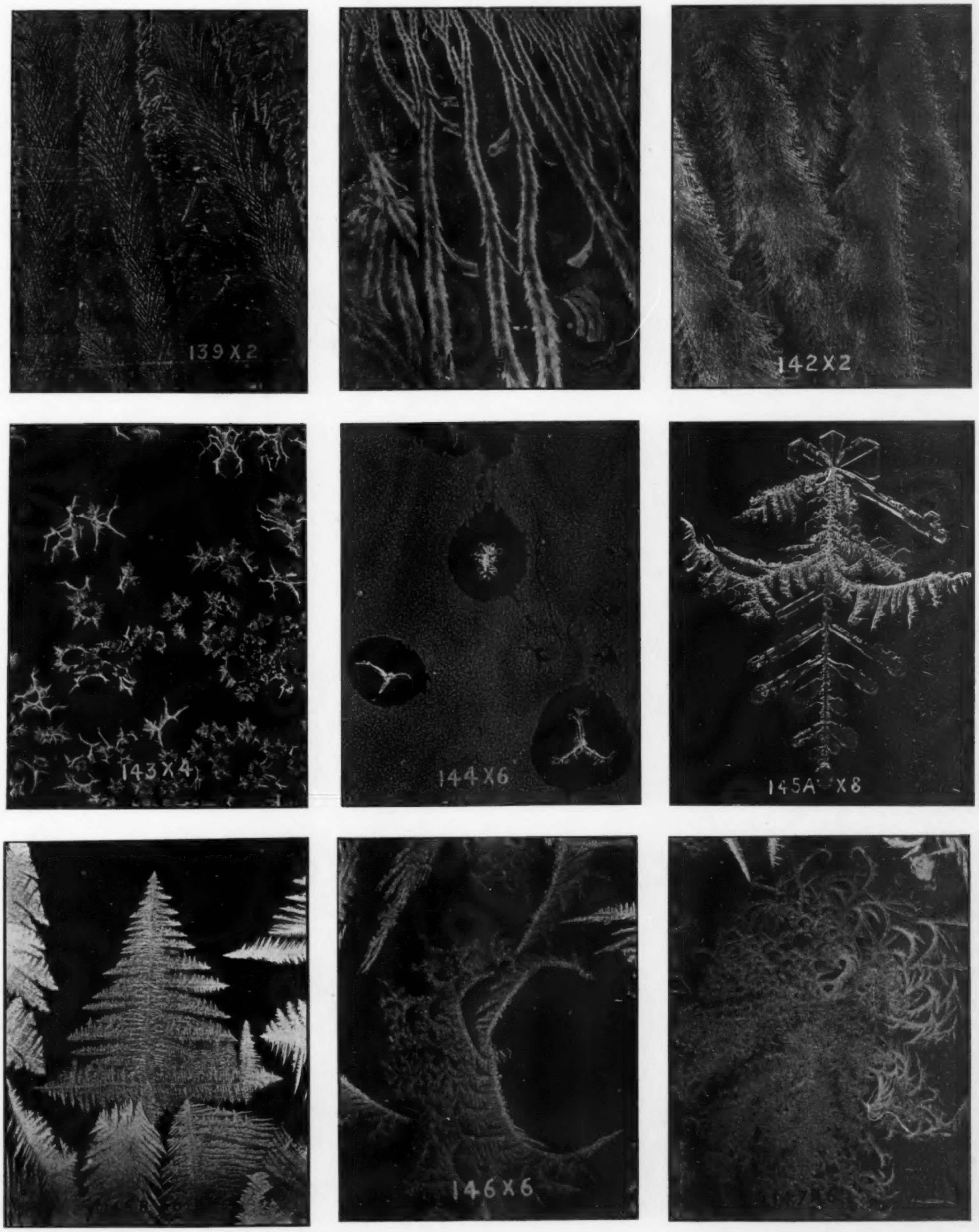
136 X $\frac{1}{3}$

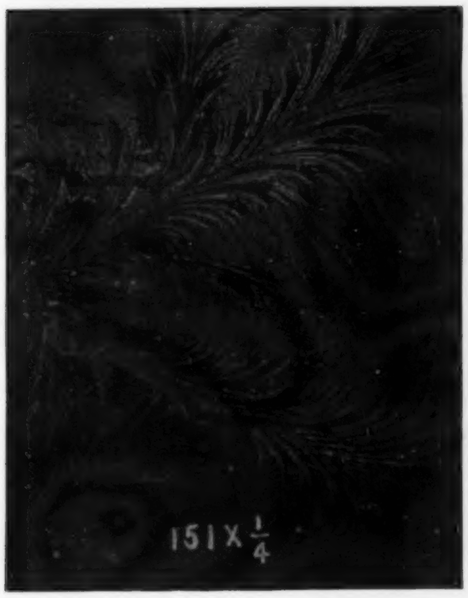

138 X $\frac{1}{3}$

Photomicrographs of Frost and Ice Crystals.



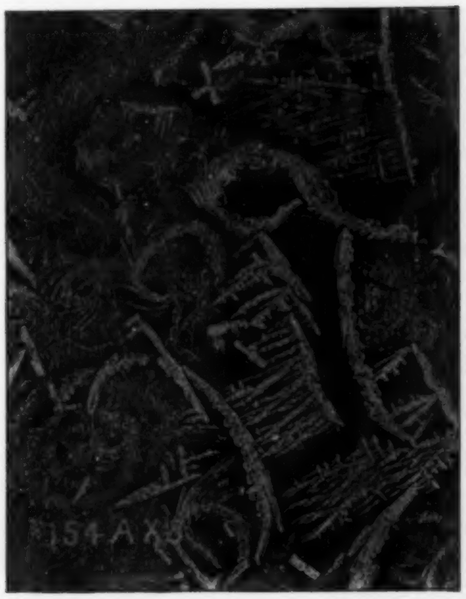

148X8


150X$\frac{1}{4}$

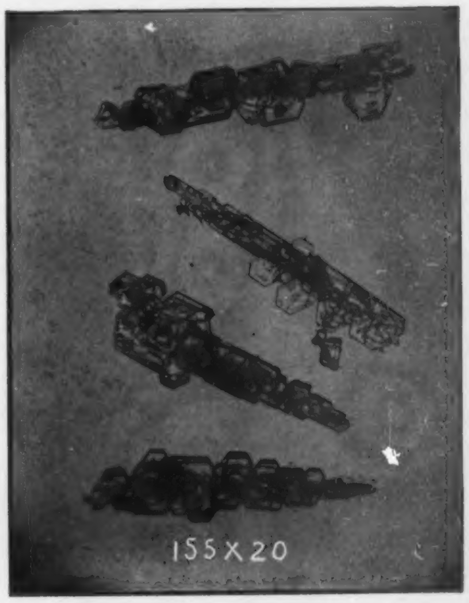

151X$\frac{1}{4}$


152X8


153X8


154AX8


154BX8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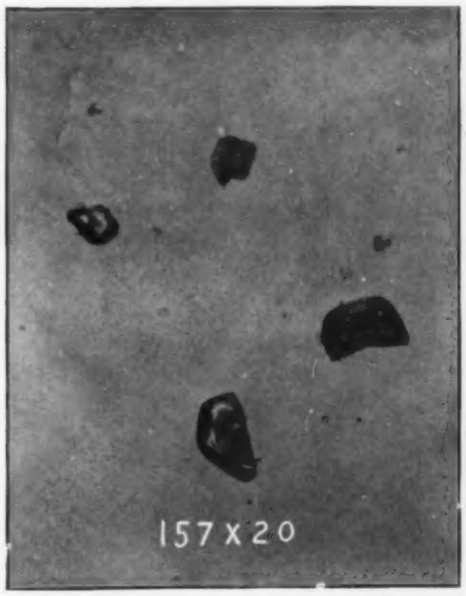
156 X 30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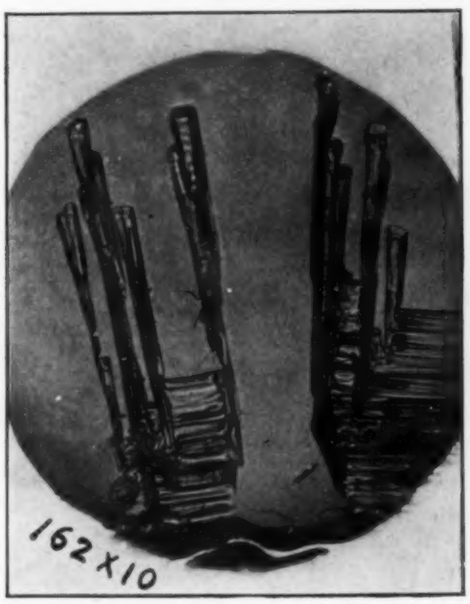
158 X $\frac{1}{10}$


159 X 2


160 X $\frac{1}{10}$


161 X 25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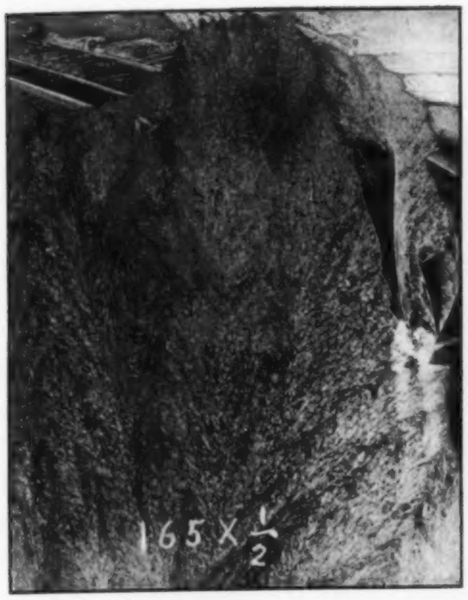
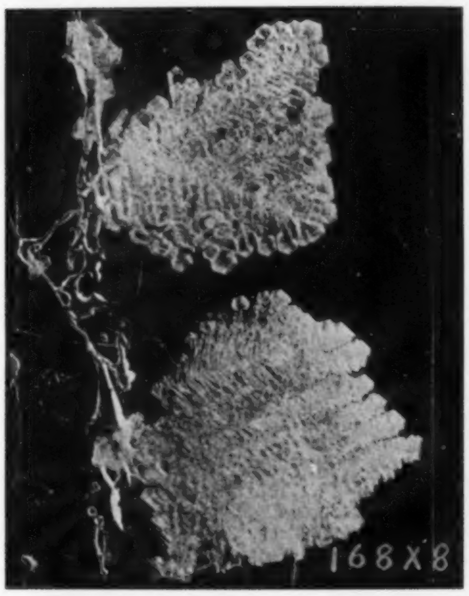
163 X 10


164 X 8


165 X $\frac{1}{2}$


166 X 6


167 X 4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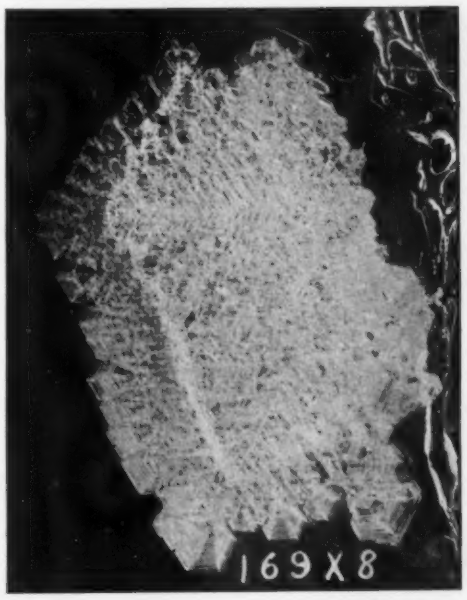
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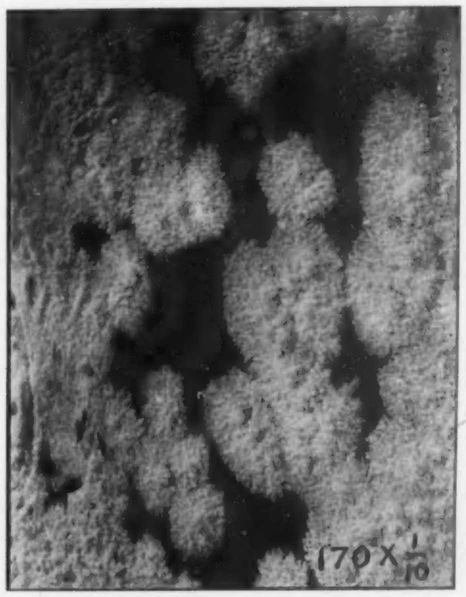
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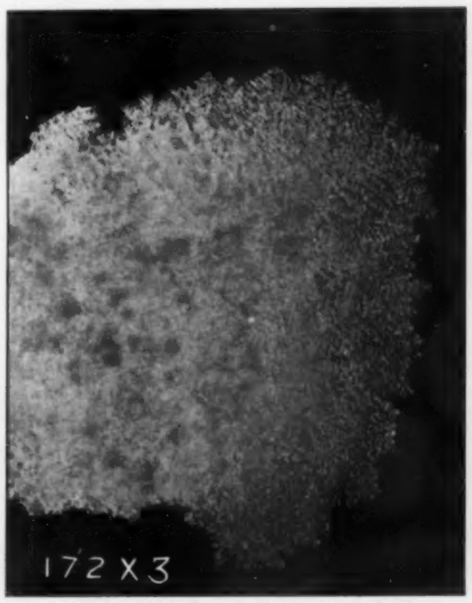
171 X 32


172 X 3


173 X 3


174 X 3
175 X 3
176 X 1/3
177 X 1/3
178 X 3
179 X 4
180 A X 24
180 B X 4
182 X 1/4

Photomicrographs of Frost and Ice Crystals.

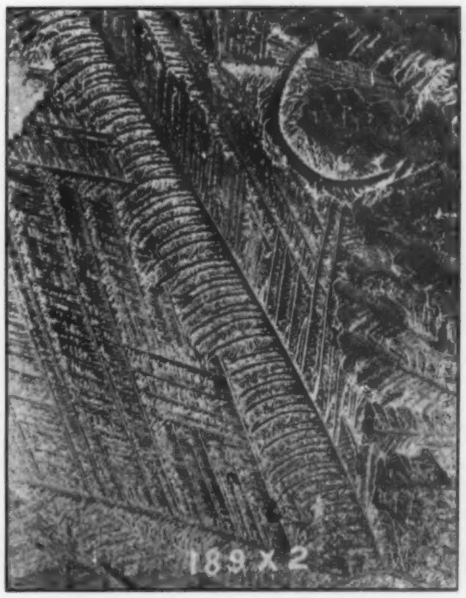
183 × $\frac{1}{4}$

185 × 1

186 × $\frac{1}{4}$

187 × $\frac{2}{3}$

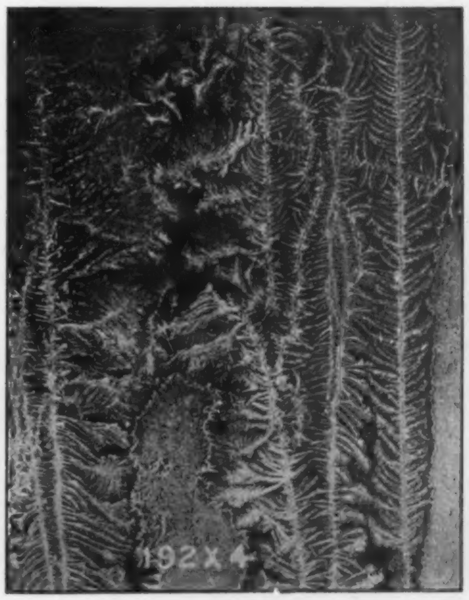
188 × 3



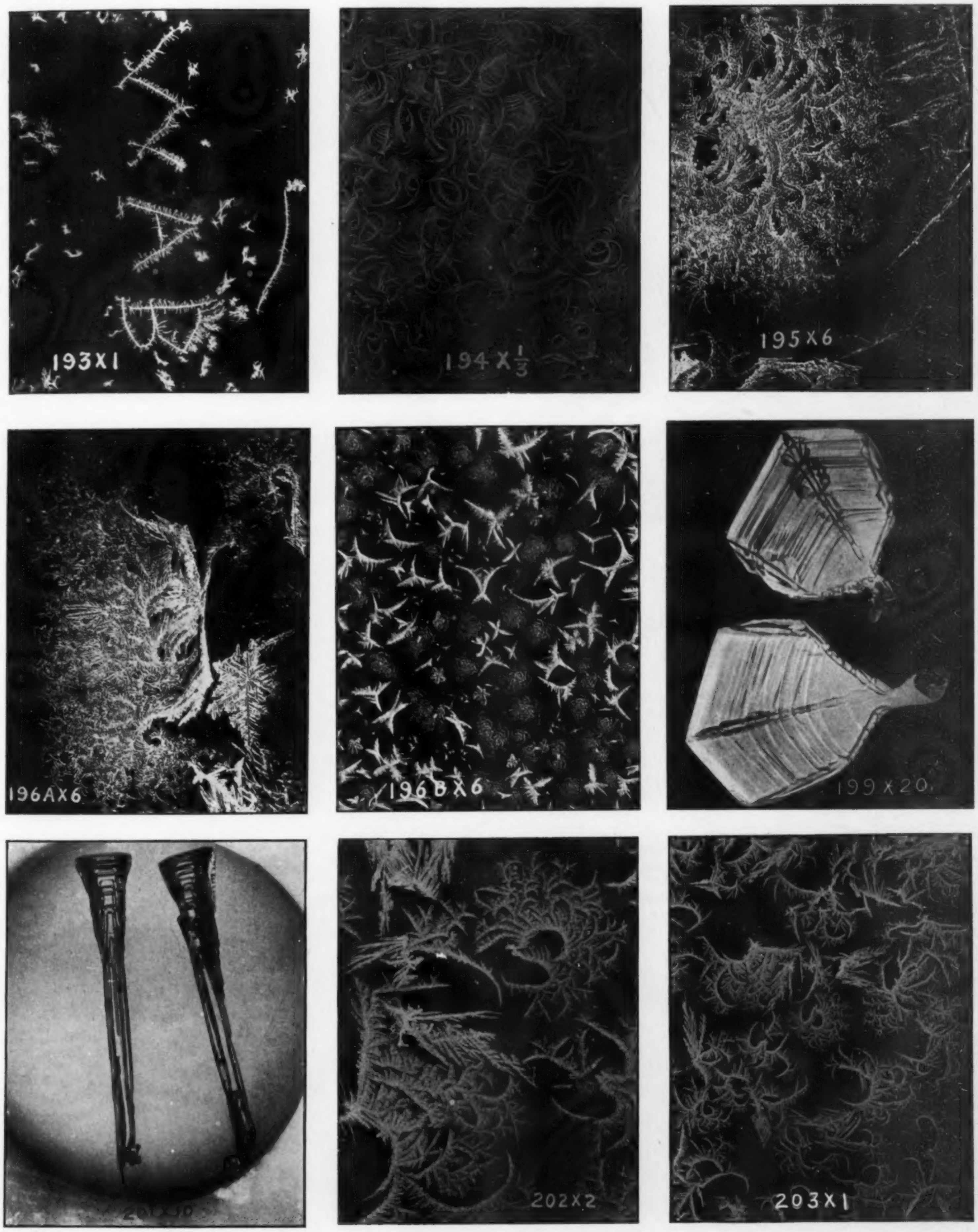
189 × 2

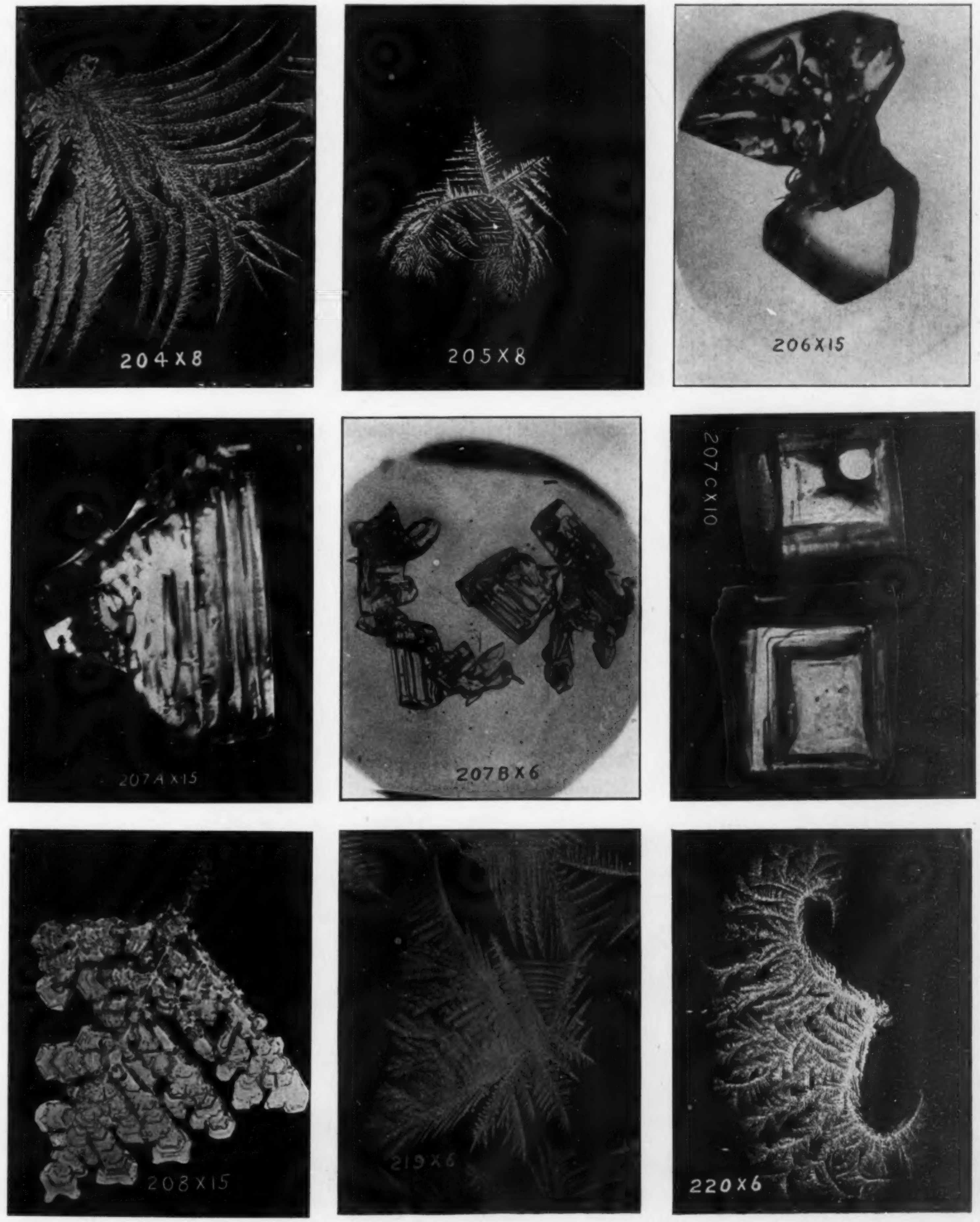
190 × 6

191 × 6



192 × 4


193X1
194X⅓
195X6
196AX6
196BX6
199X20.
202X2
203X1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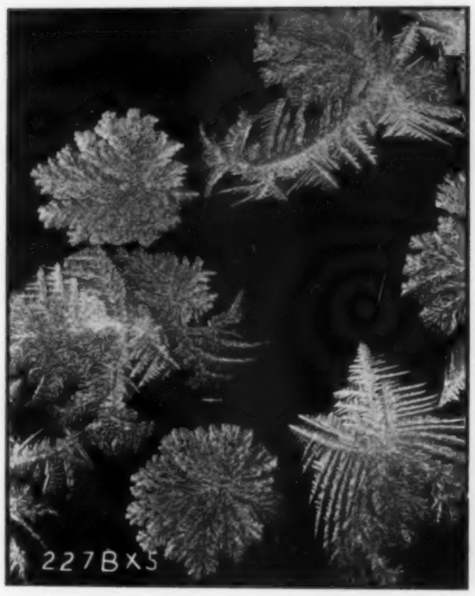
205X8
206X15
207AX15
207BX6
207CX10
208X15
219X6
220X6

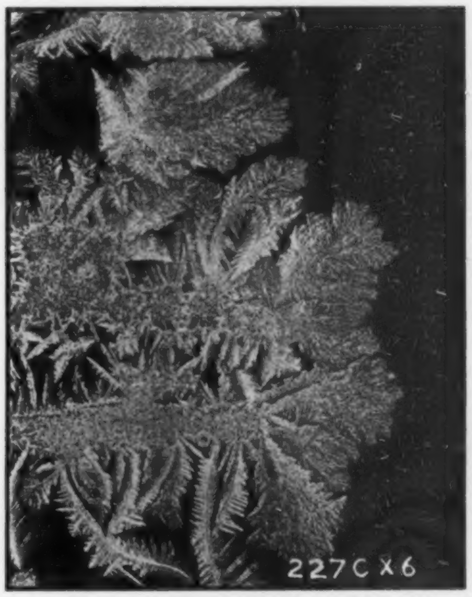

222X6


225X12


226X6


227AX6

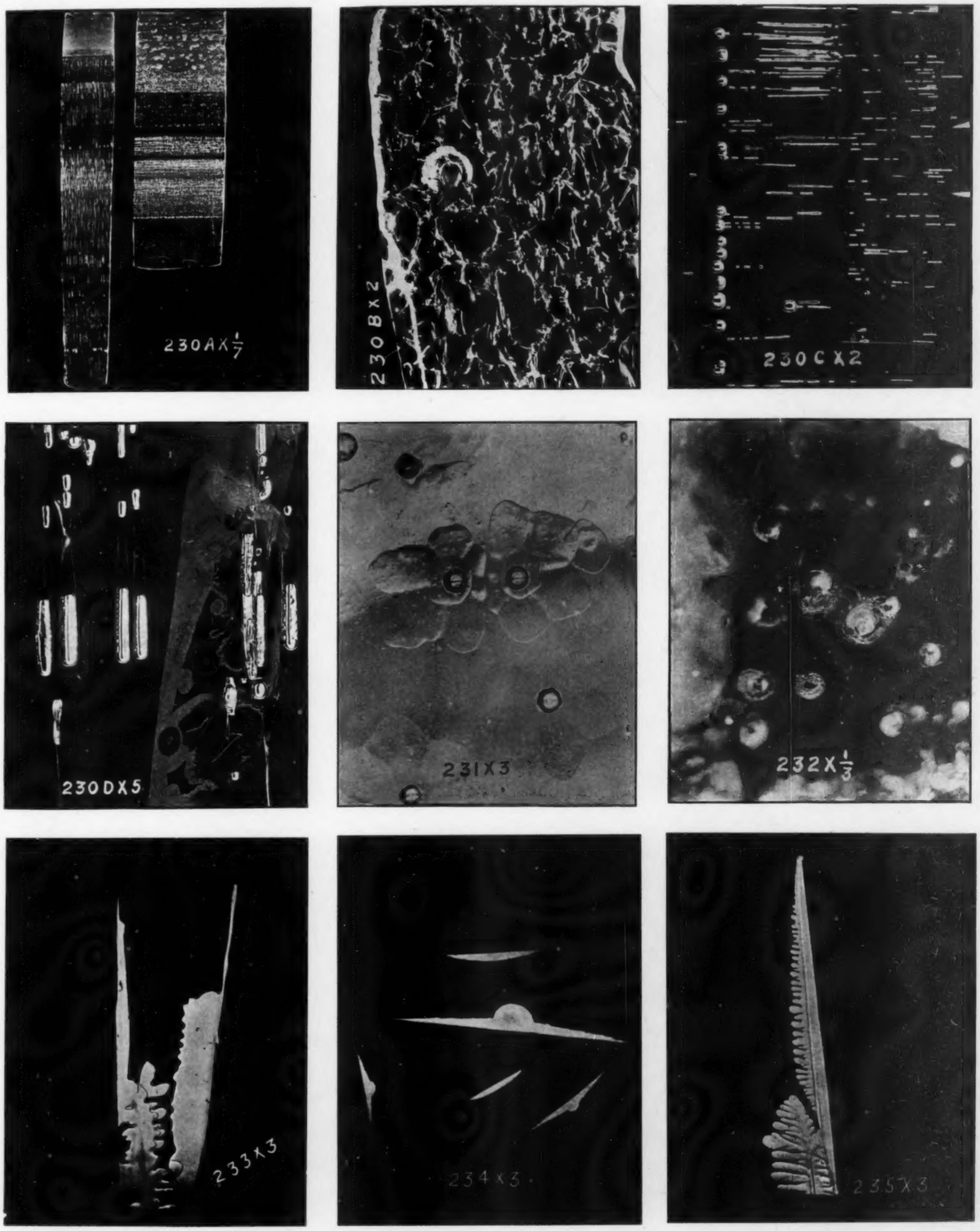

227BX5


227CX6


228X16


229AX20


229BX12


230A×1/7
230B×2
230C×2
230D×5
231×3
232×1/3
233×3
234×3
235×3


236X3

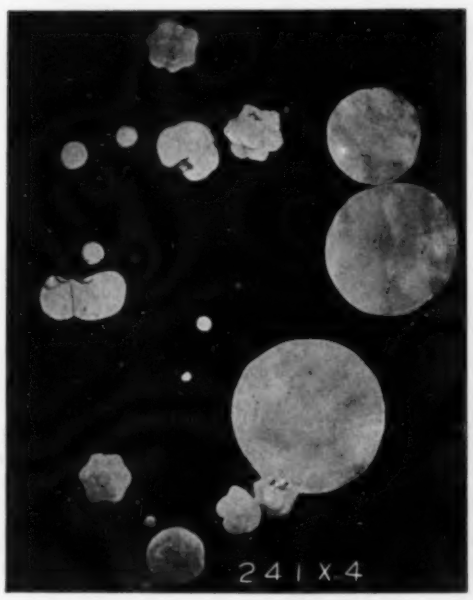

237X4


238X3


239AX1


239BX1/3


240X4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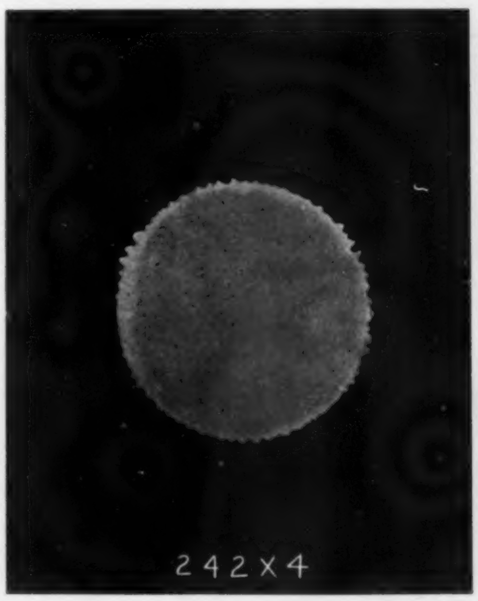
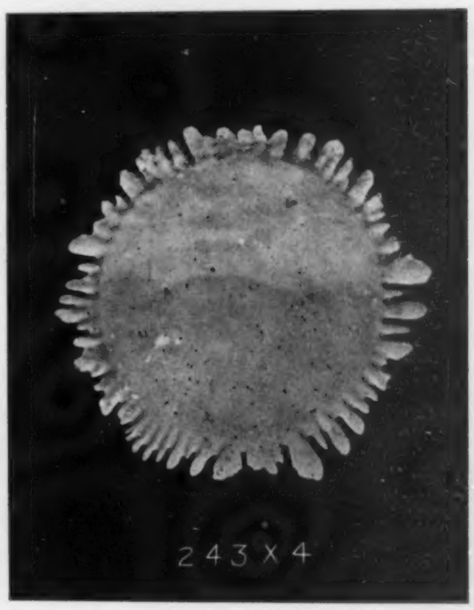
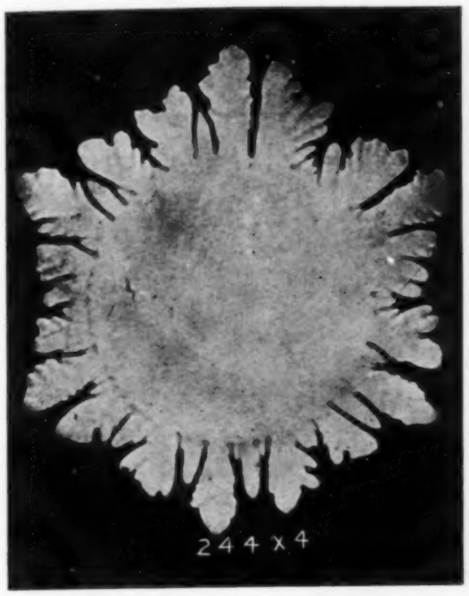
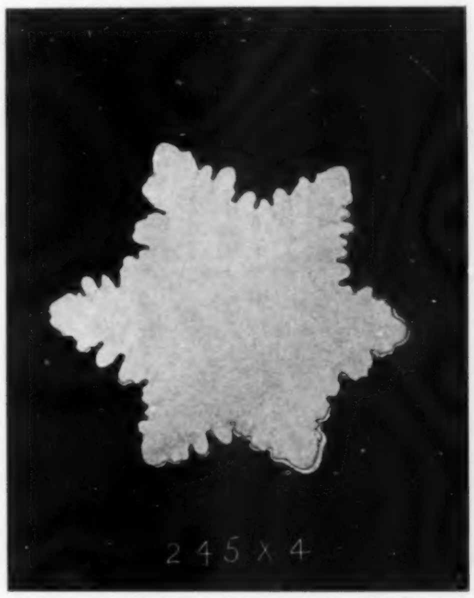

242X4

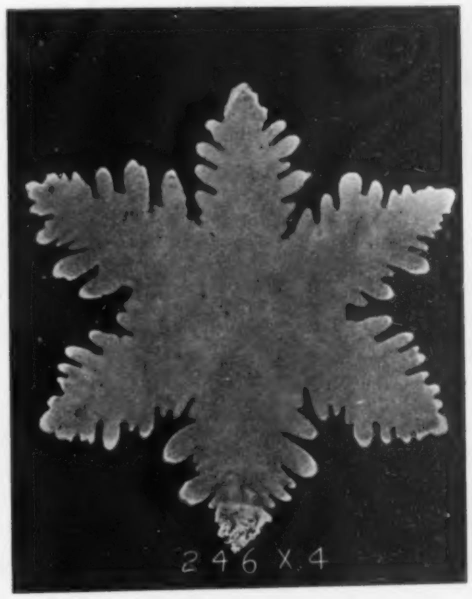

243X4

Photomicrographs of Frost and Ice Crystals.

Plate XXVIII.

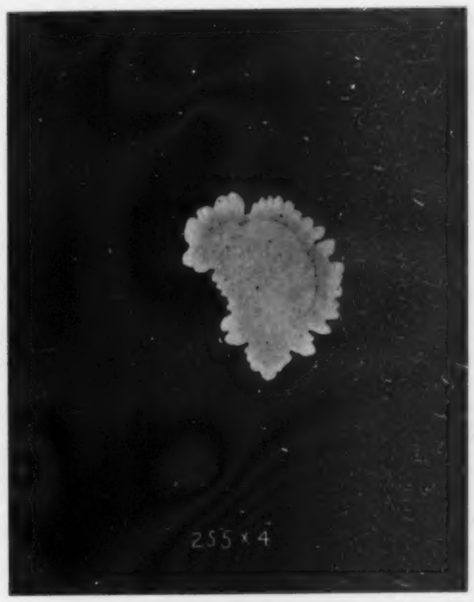


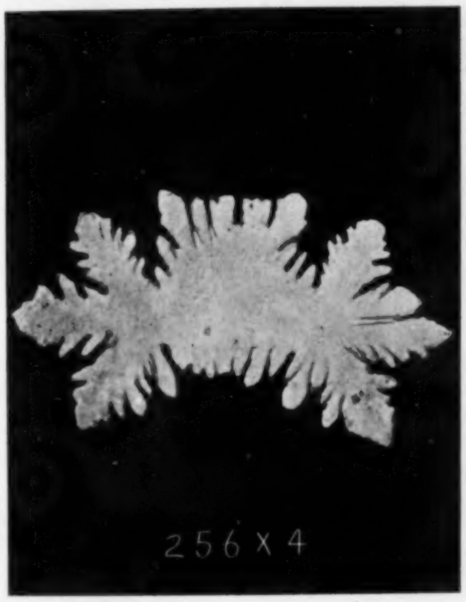





253 X 4


254 X 4


255 x 4


256 X 4


257 X 4

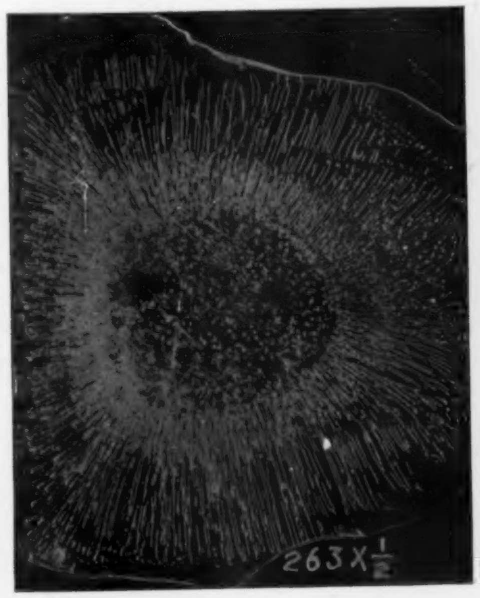

258 X 4


259 X 3

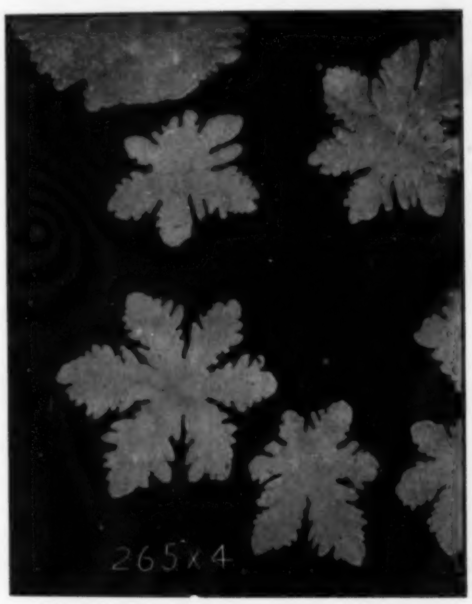

260 X 3

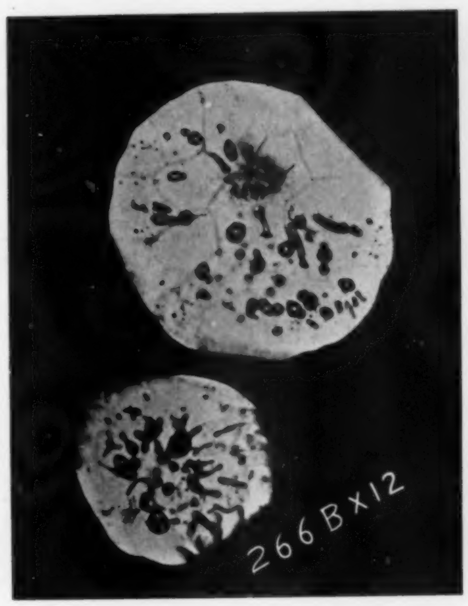

261 X 4


262 x 4


263 X 1/2

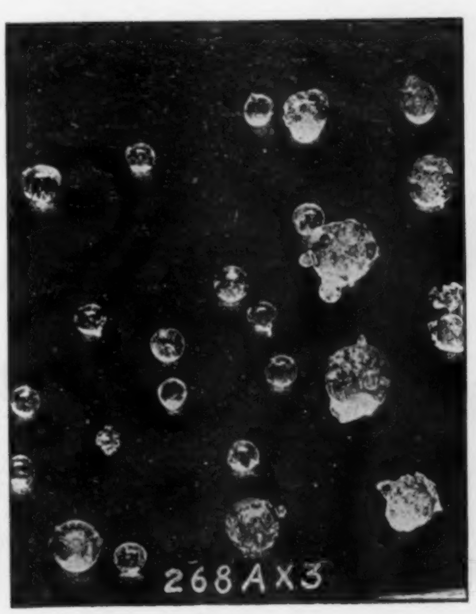

264 X 8

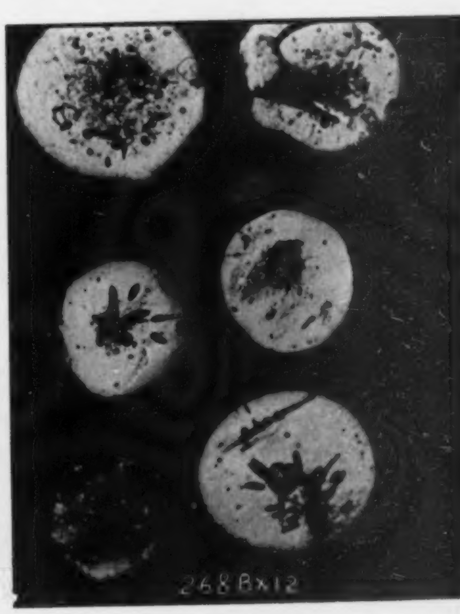

265 X 4


266 B X 12

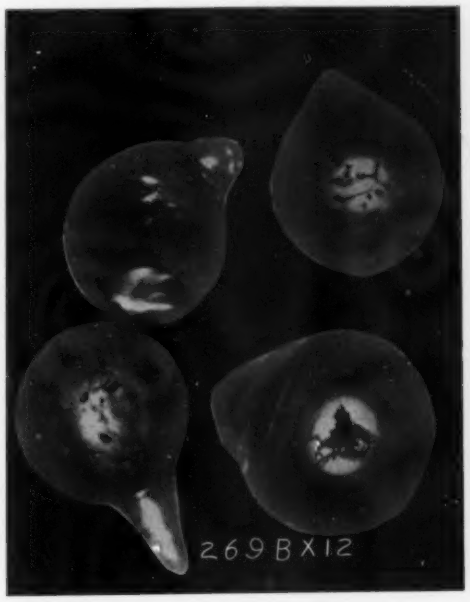

267 A X 4


267 B X 12


268 A X 3


268 B X 12


269 A x 4


269 B X 12


270 X 12


271 X 12

W. B. No. 385.

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